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ABSTRACT

Proceedings of the conference discuss issues of school reform, automation, education and the Internet, instructional learning environments, educational products, computer managed instruction, and adaptive learning environments. Seven articles include the following: (1) "Alternative Paths to School Reform" (Andrew Gibbons) discusses the state of American education, reform in education, and the nature and pace of reform; (2) "The Manufacturing of Learning: Automating the Production Process" (James J. L'Allier) a slide presentation; (3) "Education and the Internet: Who's Leading This Dance?" (Valorie Beer) supporting material for slide presentation; (4) "Designing Instructional Learning Environments" (M. David Merrill) slide presentation; (5) "A Frame of Reference: NETG's Map to Its Products, Their Structures and Core Beliefs. Discussion Paper Series" (James J. L'Allier) discusses underlying concepts, rules, and basic structures of the variety of National Education Training Group, Inc. (NETG) products; (6) "Computer Managed Instruction" (Kevin Oakes and Dick Walker) slide presentation that defines features and benefits of Computer Managed Instruction (CMI); and (7) "Adaptive Learning Environments" (ID2 Research Group) designing adaptive learning environments with PEAnets (process, entity, activity relationships). (JAK)

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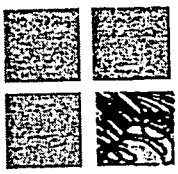

Alternative Paths to School Reform

Andrew Gibbons

Andrew Gibbons is director of the Center for the School of the Future at Utah State University in Logan, Utah.

For the past several decades, the public has been intensely concerned about the state of American education.[1] In fact, ever since the U.S. Department of Education published *A Nation at Risk* in 1983, many observers have concluded that our schools are in crisis.[2]

Governors and industry leaders attending the 1996 National Education Summit of the Nation's Governors and Corporate Leaders in Palisades, New York, came to a similar judgment. In fact, they noted, "We have students graduating from high school with diplomas that they can't read [and] who can't write a coherent sentence or do basic math."[3]

There are schools and even entire school districts that do a poor job of educating children; however, recent studies suggest that our schools are not in crisis. John Jennings, director of the Center on National Education Policy, conducted interviews with parents and teachers in more than half of the 50 states and concluded that the press has greatly amplified the problems that schools face.[4]

Similarly, in 1994, the Carnegie Corporation sponsored a task force consisting of public officials, business executives, scientists, and educational practitioners, which concluded that "contrary to popular belief, today's school children are performing about as well as their parents and teachers did 25 years ago."[5]

David Tyack and Larry Cuban of Stanford University, after reviewing a century of educational reforms in America, observed that the "public schools, for all their faults, remain one of our most stable and effective public institutions—indeed, given the increase in social pathologies in society, educators have done far better in the last generation than might have been expected."[6]

Students themselves believe that schools are doing a good job. In a nationwide survey of student attitudes toward education, which was conducted by Louis Harris and Associates in 1996, 70 percent of the respondents rated schools positively, while 75 percent were satisfied with their teachers.[7]

David Berliner of Arizona State University and Bruce Biddle of the University of Missouri echo these sentiments in a book whose title, *The Manufactured Crisis*, describes their appraisal of the situation.[8]

These authors draw on a wide range of readily available statistics to contradict claims that our schools are in trouble.[9] Such views, although not extensively publicized in the press, offer a useful antidote to the prevailing attitude that the nation's schools are losing ground.

This is not to suggest that we should accept our schools just the way they are or that there's no room for improvement. The fact is, most people agree that some type and amount of educational change is in order. Indeed, because change is inherent in hu-

man organizations, it is difficult to see how things could possibly remain the same.

However, the philosophies and principles guiding educational change differ, often significantly, in their prescription of the methods for promoting change, the best pace for change, and the nature of the changes themselves.

Paths of Reform: Teachers

Berliner and Biddle acknowledge that our schools have problems. However, they argue that solutions require step-by-step changes, not wholesale reforms like those that have been tried in the past. The latter efforts, they contend, most often ignore centuries of experience. In trying to change everything at once, we run the risk of throwing out the baby with the bath water.

Tyack and Cuban, on the other hand, propose that schools should be viewed as organic institutions that cannot be altered by edicts from above. They cite historical evidence showing that for more than 100 years, efforts at top-down reform have failed. As a result, they predict:

> Better schooling will result in the future—as it has in the past and does now—chiefly from the steady, reflective efforts of the practitioners who work in schools and from the contributions of the parents and citizens who support (while they criticize) public education. This might seem to be just common sense.[10]

Tyack and Cuban also point out that this type of thinking has been largely ignored in the educational reforms of the past decade. For the most part, neither public officials nor school administrators have asked teachers to participate actively in shaping the reforms, though teachers have had to live with the consequences of those measures.

In addition to eliminating teacher influence on reform decisions, past reform has been flawed by a tendency toward faddism—that is, a predisposition to follow the prevailing trends. Indeed, it is a serious problem that schools often adopt new practices because they have become fashionable. Such measures often take hold without much evidence to indicate whether they will succeed. Many of these initiatives, in fact, fall far short of their objectives, yet schools continue to bounce from one unproven strategy to another, wasting precious resources and time in the process.

As a consequence, school systems across the nation fail to build systematically on their past experiences. In fact, some careen from one fad to another. Consider, for example, California's 1988 statewide adoption of the whole-language reading program, to the exclusion of instruction in phonics. After reading scores plummeted, California abandoned the use of the whole-language method in June 1996.[11]

The antidote to faddism is incremental change and change based on the results of sound research. Educators in general and classroom teachers in particular not only must become familiar with that research, but they also must come to believe that it supplies useful information that can be applied in solving their everyday problems.

Mountains of research describe the process of learning and the art of teaching. Research observations, however, seldom reach the classroom. Why? It appears as if educational researchers and teachers live in two different worlds.

Patricia Alexander, a researcher in human development at the University of Maryland, and her associates note that many classroom teachers, even when they readily adopt reform innovations, "do not have an extensive knowledge of the literature or research that underlies these innovations."[12]

Increased adoption of research-supported innovations will give relevance to the findings of the researchers while incrementally improving the working conditions and performance of teachers.

The success of such efforts ultimately will lie not just in more vigorous interaction between researchers and teachers but in our ability to distribute research findings to schools across the nation in a form accessible to teachers.

It is ironic that teachers and researchers, whose job it is to communicate, have not done so with each other. Moreover, communication networks must reach beyond research offices and classrooms to the nation's communities. Every member of the community—from parents to business leaders to police officers—plays a role in a successful educational system.

Whereas the pivotal role of teachers in bringing about educational change is obvious, the role of parents is less apparent to many. However, several decades of research reinforce the value of parent involvement. Indeed, involving parents in education makes intuitive sense, and re-

search supports that belief.

Many benefits have been linked to parental involvement in education, including increased student achievement, a sense of empowerment among parents, improved school attendance, and lower dropout rates.[13]

Future Schools

Concerns for the future of American public education sparked the creation in 1996 of the Center for the School of the Future at Utah State University. Pulitzer-Prize-winning journalist Jack Anderson, Utah State University President George Emert, and Wendell Butler, head of the Young Astronauts Program headquartered in Virginia, were responsible for founding the center.

The center's strategy is based on the premise that the U.S. educational system is not broken. Instead, it contends that the system's performance leaves much room for improvement but that such improvement is best accomplished through incremental reforms implemented by teachers and parents.

Throughout its assessment, the center focuses on the critical importance of supporting social and cultural values, applying sound educational research, and promoting learning and change in the context of other community processes.

These focal points tend to inspire reforms that begin from within the system—not from the top down—and proceed step-by-step over time at a pace determined by those implementing change. Along the way, the center remains committed to observing the results of each change before progressing to the next step.

Diffusion Research

Diffusion research explores the processes that control social change. It is founded on the premise that societies naturally change and that nothing remains the same. Diffusion research, moreover, suggests that change can be supported and guided, as planners and marketers have discovered.

Everett Rogers, a renowned diffusion researcher, explains that change at the societal level is the result of commitments made and actions taken by individuals. In the past, top-down educational reforms often failed because they didn't acknowledge the essential role of individual teachers in bringing about the proposed changes.[14]

Ultimately, teachers, who face students daily, are the ones who must implement change. Denying them a role in devising the reform measures and determining how they will be implemented makes no sense at any level.

The tools and approaches from diffusion research have been largely ignored by most advocates of educational reform because they have failed to place teachers and parents at the very center of the change process.

The sad truth is that at present we know more about what compels an average shopper to purchase corn flakes than we do about what convinces an average teacher to adopt a new teaching strategy.

But this much we do know: Teachers are more likely to acquire information, not in quiet isolation, but in lively environments that encourage communication and interaction among themselves. Such strategies involve the creation of networks where information and experience are exchanged.

The Learning Community

The principle of a learning community recognizes that any group—school, community, or business—has its own informal system for educating its members. This system forms, not because it is planned or designed, but because it is the way humans act within groups.

Jean Lave and Etienne Wenger, while collaborating at the Institute for Research on Learning in Palo Alto, California, identified several key principles by which organizations transmit knowledge and monitor their internal practices.

Lave and Wenger contend that these principles, by definition, apply to teachers in public schools because teachers are part of an organization of like-minded people who share similar experiences. As Lave and Wenger have found, there exists among all groups, including teachers, an informal system for cooperative self-education.

In the schools, this system of learning is closely related to the fabric of teacher-to-teacher relationships: interpersonal relationships that take place as a function of carrying out everyday work. And it is this system that has proven most resistant to the change patterns of the past which have been imposed from the top down.

The principles behind a learning community suggest that the formation of networks among teachers may pose a powerful alternative to top-down reforms

imposed through administrative channels.

With this in mind, reformers should seek to strengthen and support the learning community of teachers. In so doing, they will encourage teachers to support and implement reforms, rather than resist them.

What We Face

As we approach the 21st century, American society faces tremendous educational challenges. We have aspired to teach an enormously diverse student population, and we have set the ambitious goals of preparing each student to participate successfully in a complex democratic society and a highly competitive world economy.

We believe these goals can be reached only if reform efforts involving teachers and parents are based on sound research and experience, take advantage of the principles and practices of the learning communities, and provide appropriate information and support systems for the diffusion of innovative ideas and practices.

■■■■

NOTES

1. Members of the Executive Committee of the Center for the School of the Future include James Cangelosi, Andrew Gibbons, Deborah Hobbs, Linda L'Ai, Dephine Rossi, Timothy Slocum, Ron Thorkildsen, and Lani Van Dusen.

2. The National Commission on Excellence in Education, *A Nation at Risk* (Washington, DC: GPO 065-000-00177, April 1983).

3. National Education Summit (March 1996), *Policy Statement*, (available at http://www.summit96.ibm.com).

4. In 1994, John Jennings traveled the nation observing schools. He outlined his findings in "Travels Without Charley," *Phi Delta Kappan* (September 1996).

5. *Years of Promise: A Comprehensive Learning Strategy for America's Children* (NY: Carnegie Corporation's Task Force on Learning in the Primary Grades, 1994).

6. David Tyack and Larry Cuban, *Tinkering Towards Utopia: A Century of Public School Reform* (Cambridge, MA: Harvard University Press, 1995), p. 38.

7. *The Metropolitan Life Survey of the American Teacher* (NY: Louis Harris and Associates, Inc, 1996).

8. David C. Berliner and Bruce J. Biddle, *The Manufactured Crisis: Myths, Fraud, and the Attack on America's Schools* (Reading, MA: Addison Wesley Publishing Company, 1995).

9. For a list of the sources that Berliner and Biddle relied on, see "Perspectives on Education in America: An Annotated Briefing," *Journal of Educational Research* 86 (1993), pp. 259-310.

10. Tyack and Cuban, *Tinkering Toward Utopia*, p. 135.

11. Art Levine, "Parents Report on America's Reading Crisis," *Parents* (October, 1996), pp. 63-68.

12. Patricia A. Alexander, "Of Squalls and Fathoms: Navigating the Seas of Education Innovation," *Educational Researcher* 25 (April 1996), pp. 31-36, 39.

13. M.R. Stein and R.J. Thorkildsen, *Using What We Know* (Logán: Utah State University, newsletter, 1995).

14. "To bring about improvement at the heart of education...has proven to be the most difficult type of reform, and it will result in the future more from internal changes created with the knowledge and expertise of teachers than from decisions of external policymakers," Tyack and Cuban, *Tinkering Toward Utopia*, pp. 134-135.

THE MANUFACTURING OF LEARNING:
AUTOMATING THE PRODUCTION PROCESS

JAMES J. L'ALLIER, PH.D.
VICE PRESIDENT
PRODUCT DEVELOPMENT

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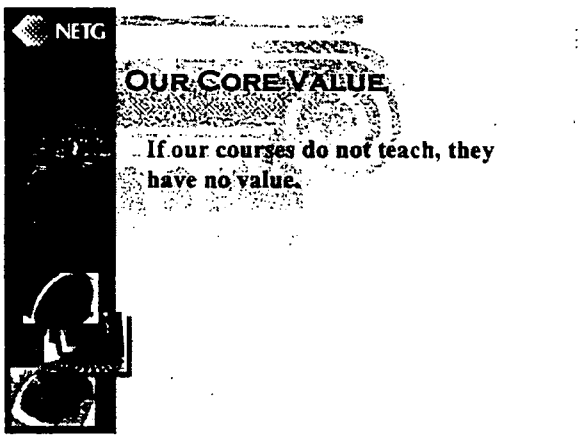

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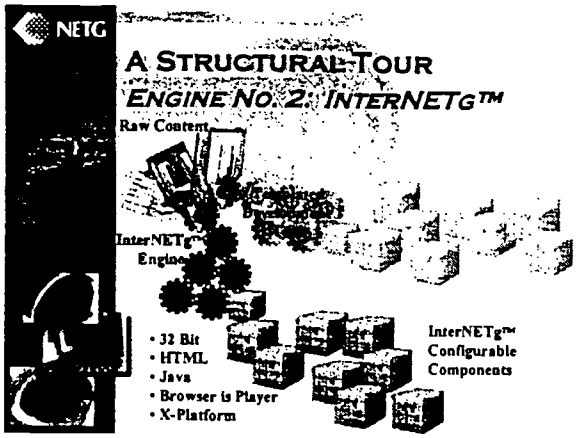

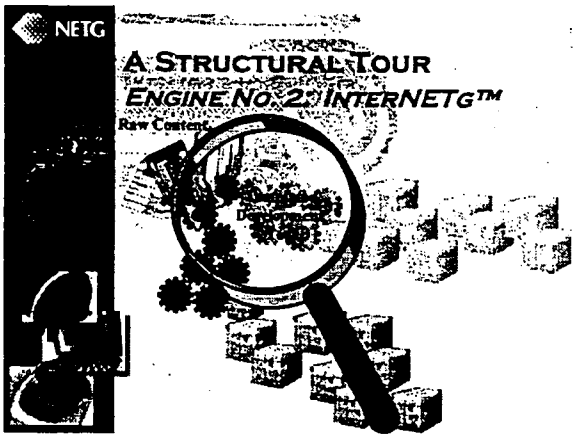

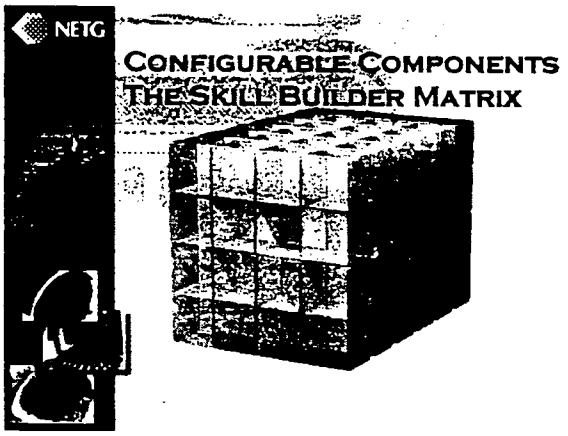

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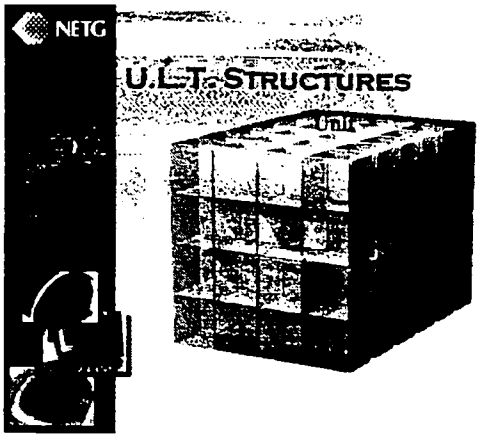

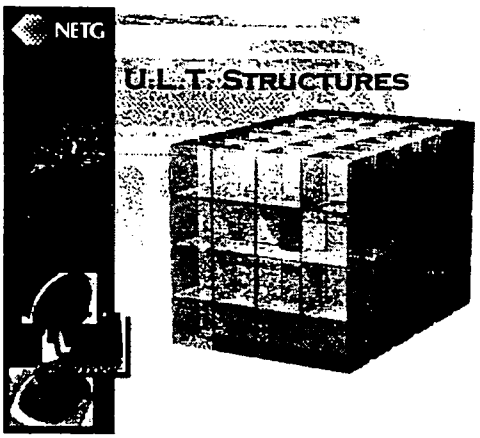

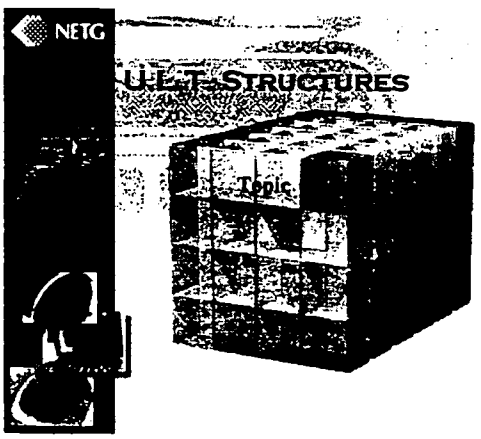

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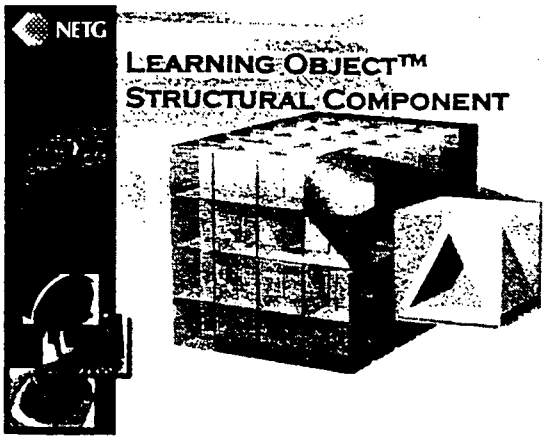

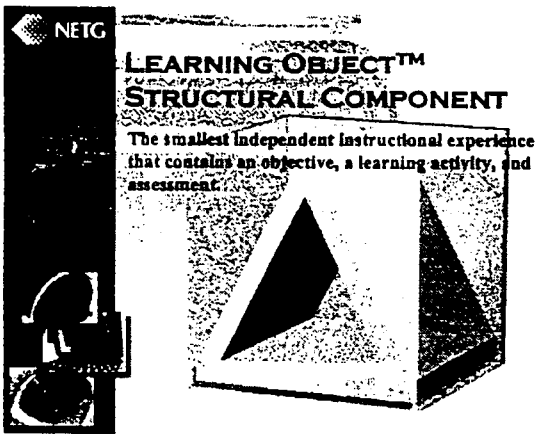

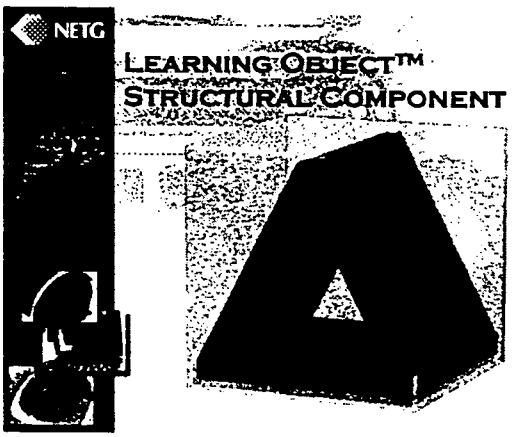

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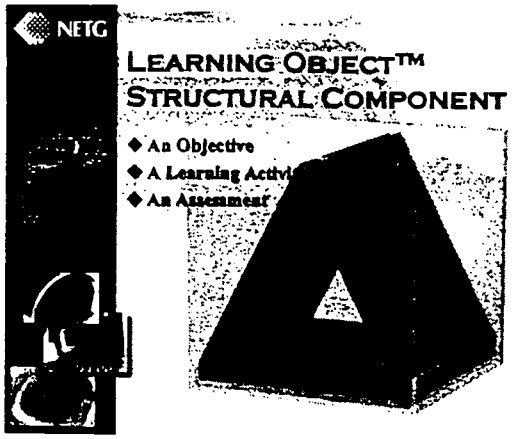

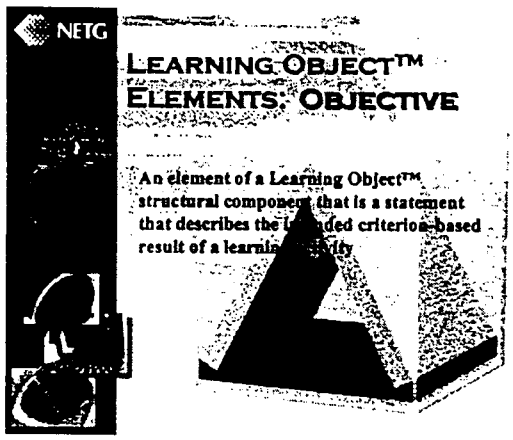

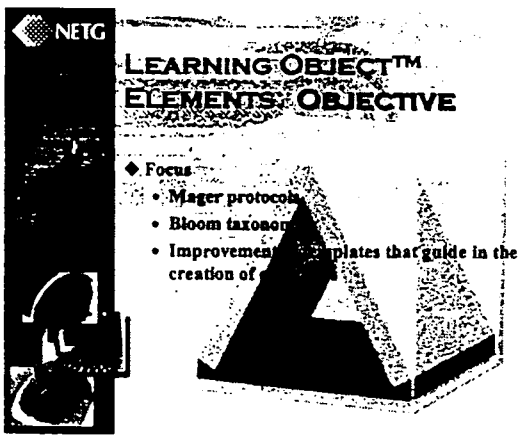

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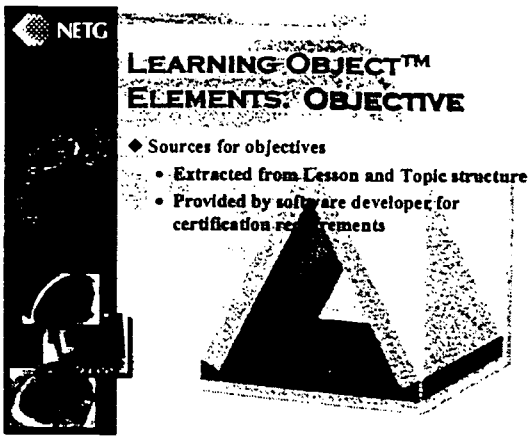

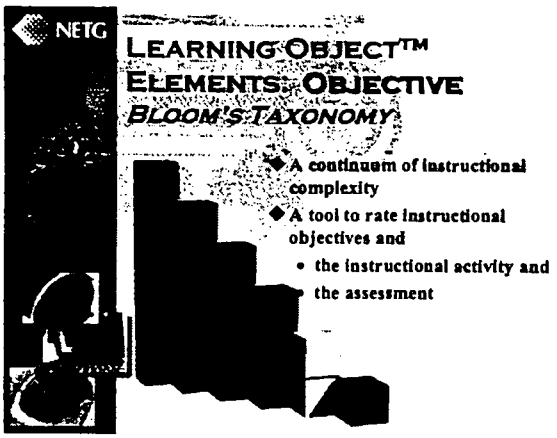

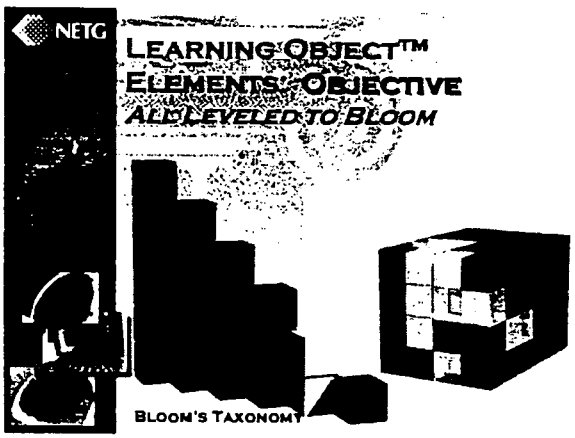

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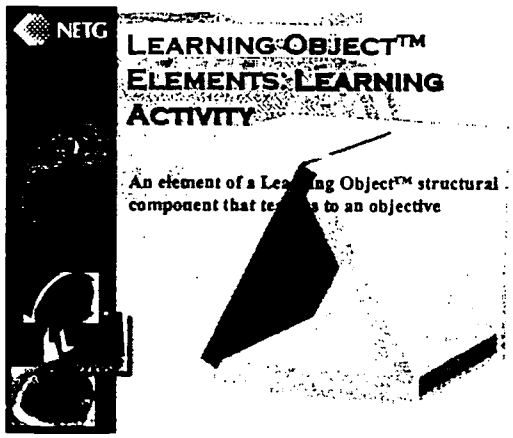
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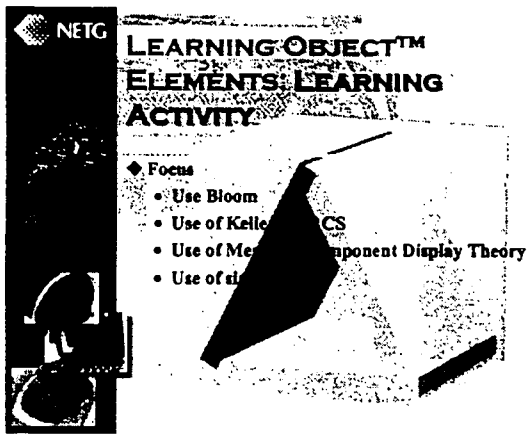
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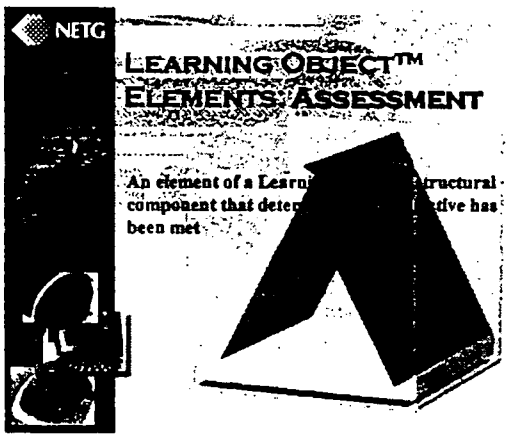
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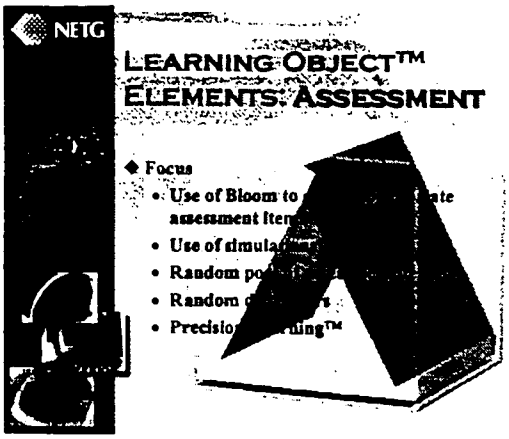

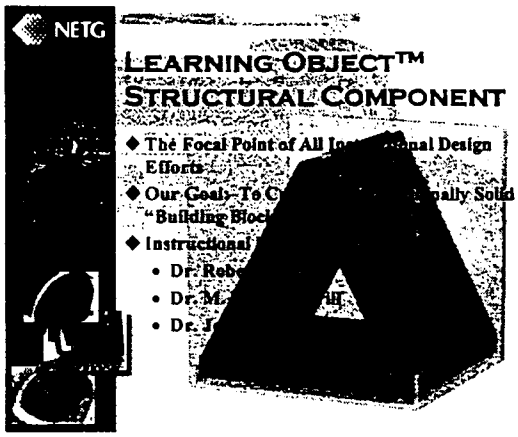

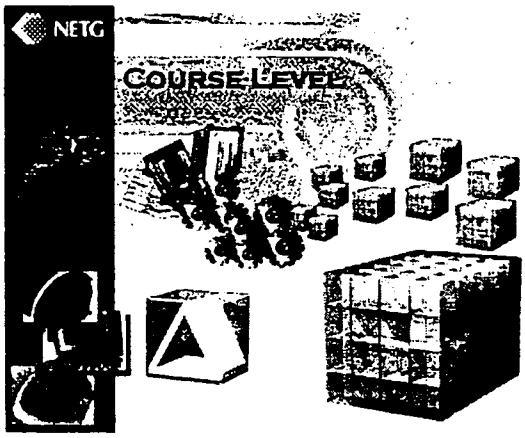

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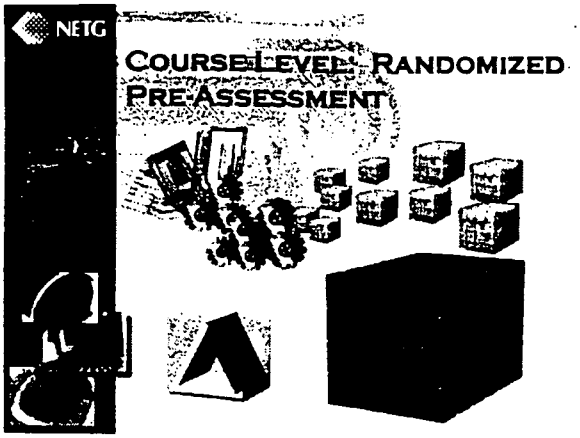
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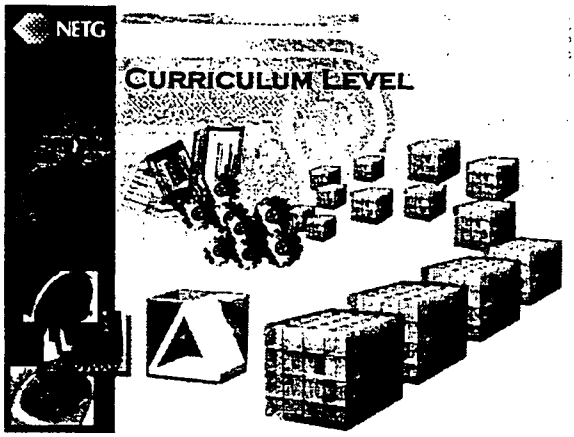

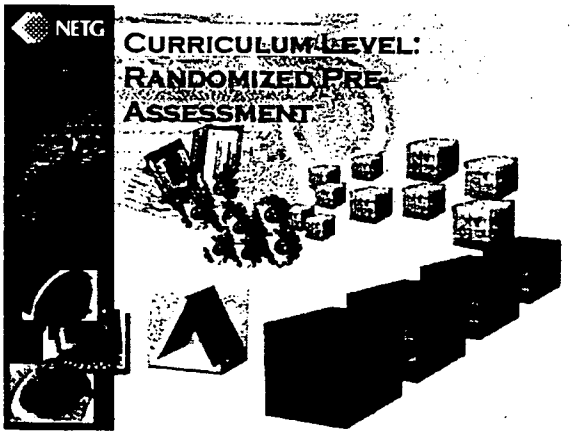

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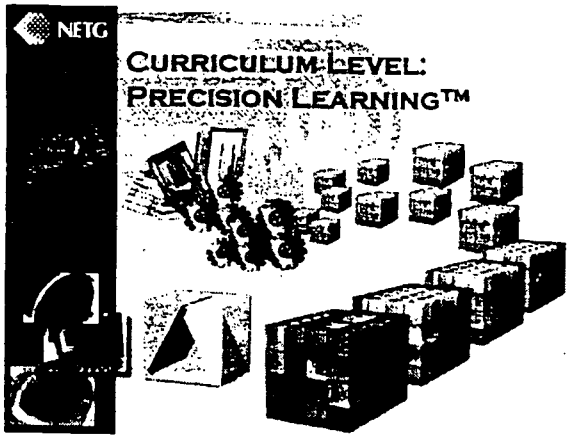

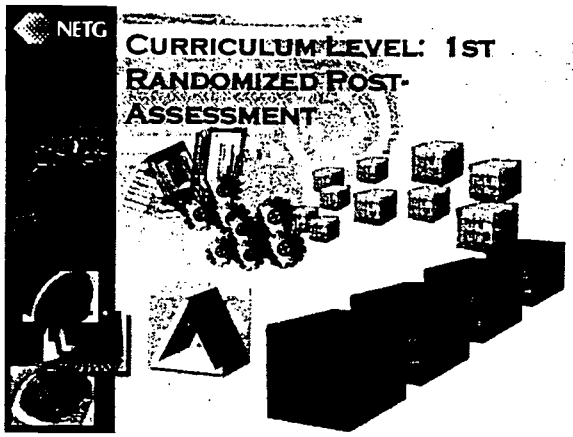

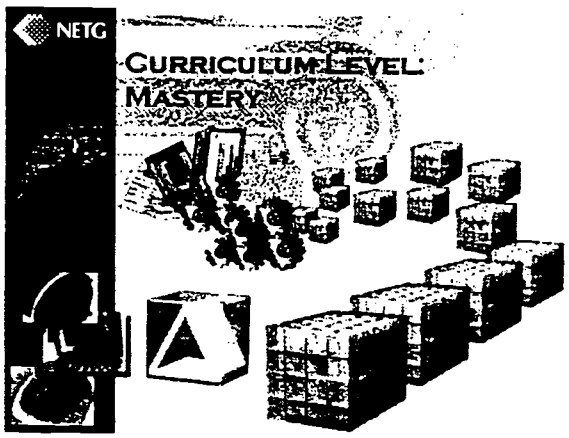

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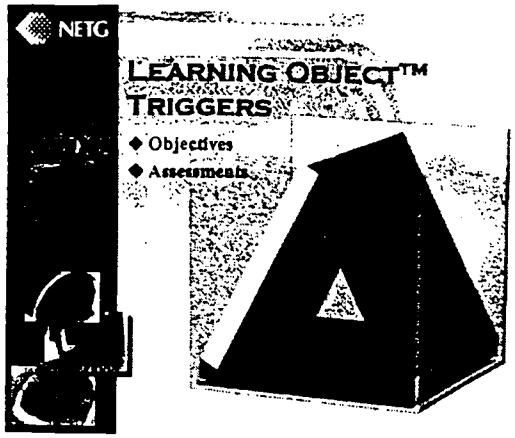

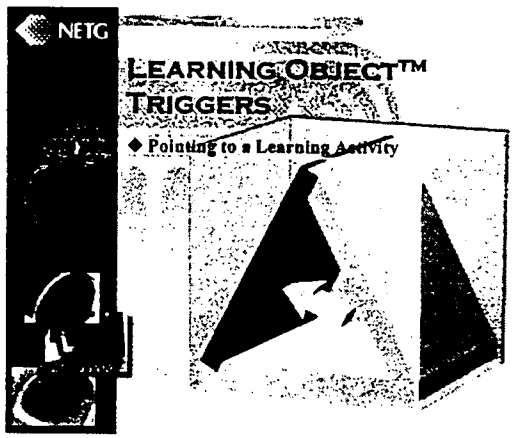

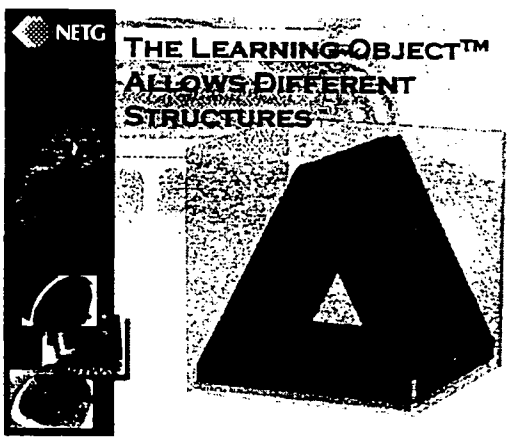

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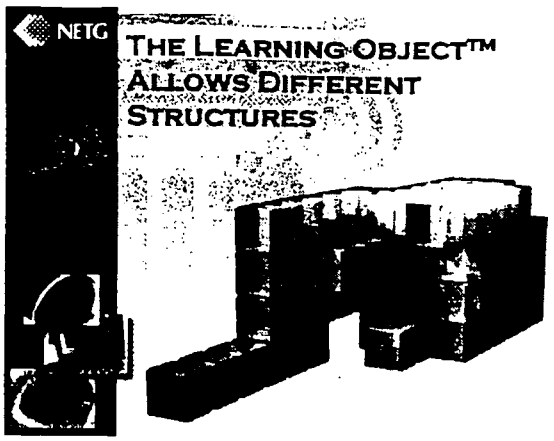

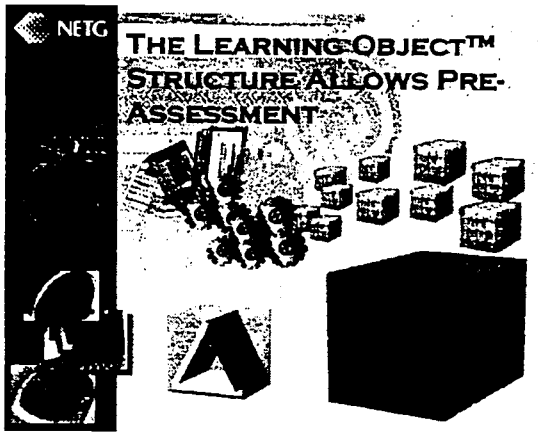

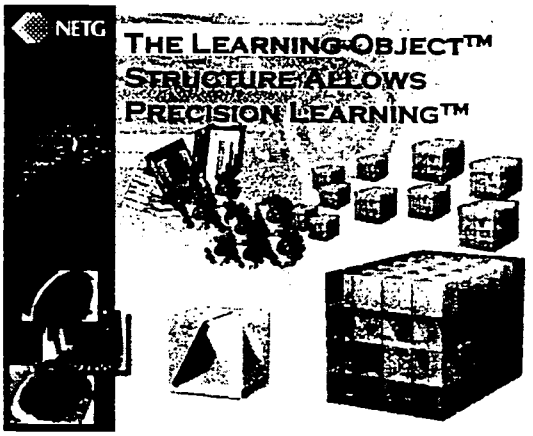

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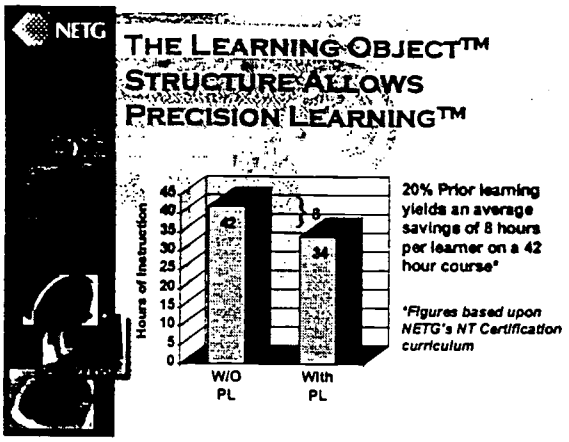

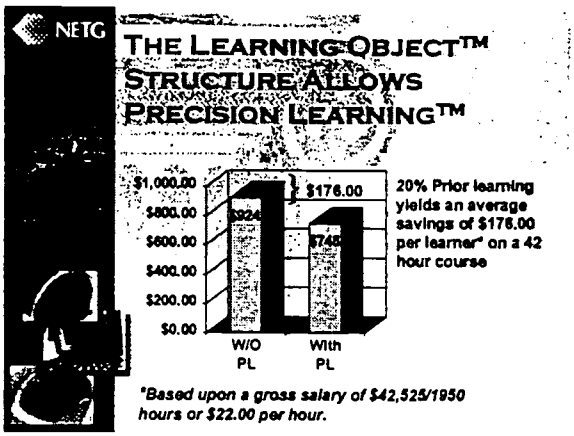

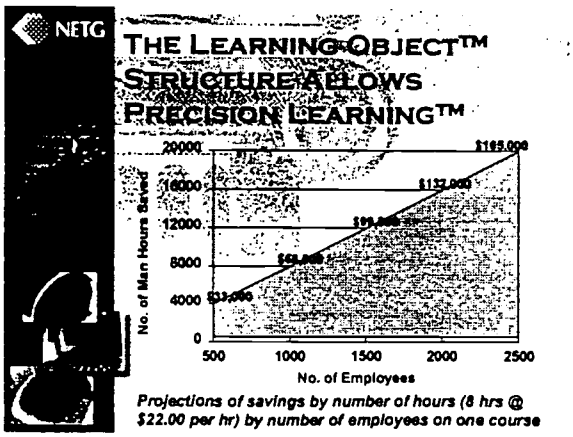

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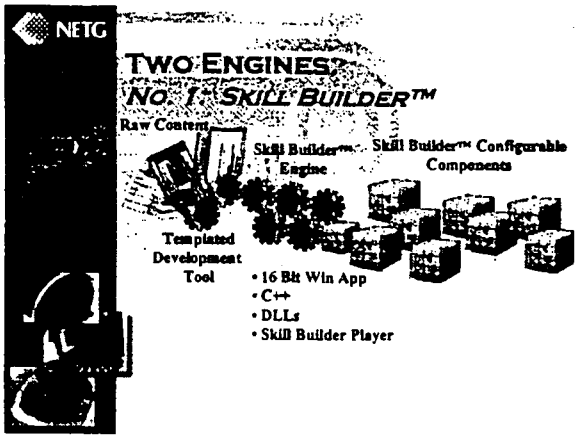

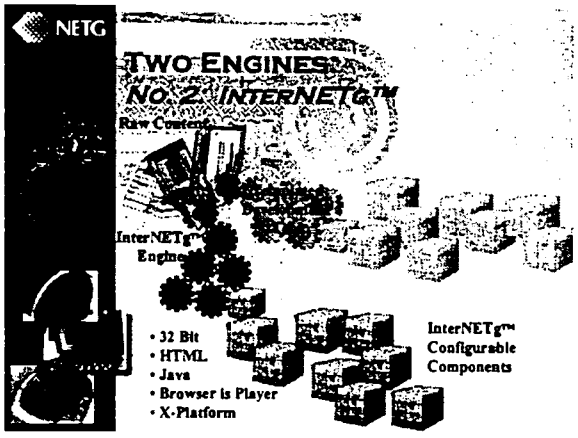

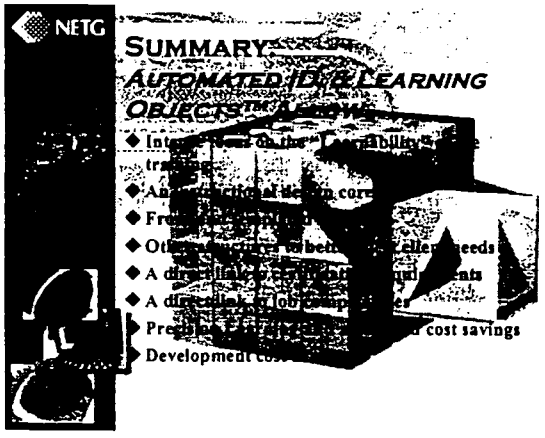

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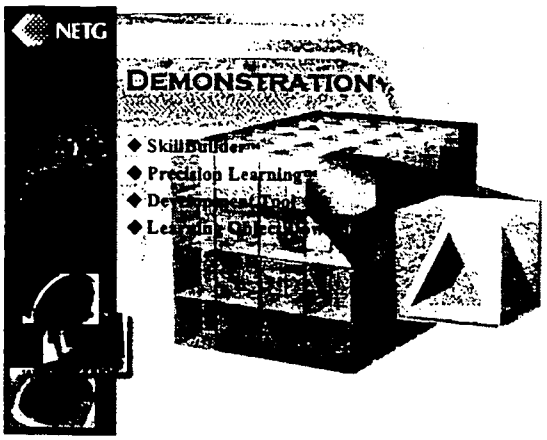

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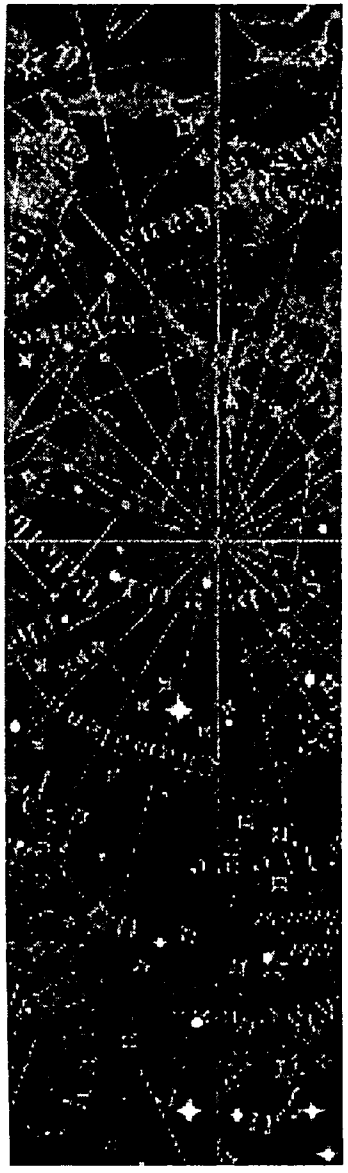

Education and the Internet:

Who's Leading This Dance?

Valorie Beer
Netscape Communications Corp.

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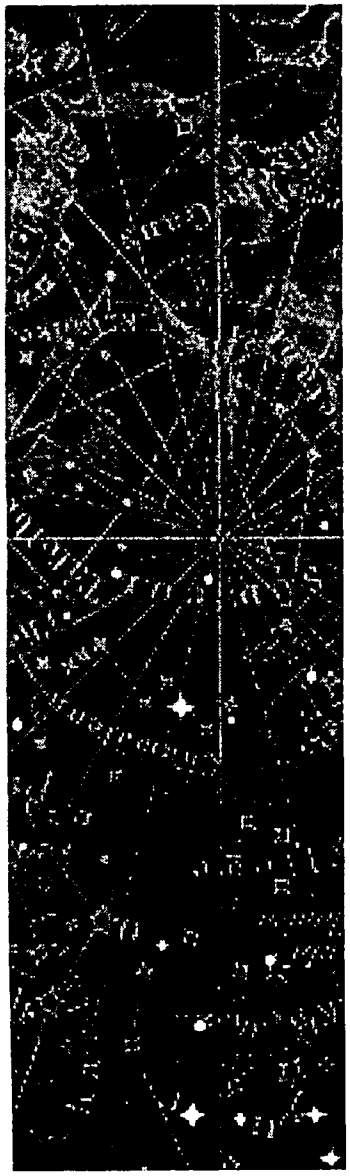
The Problem



Talking about

web-based learning

is like talking about

oven-based eating.

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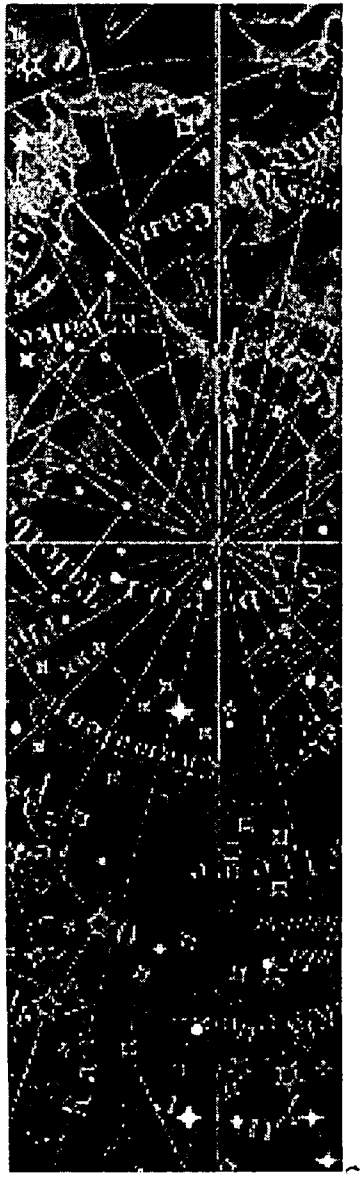
Good News / Bad News



Good news #1:
Accessing information, help, and news is easier

Bad news #1:
Sifting and sorting is harder

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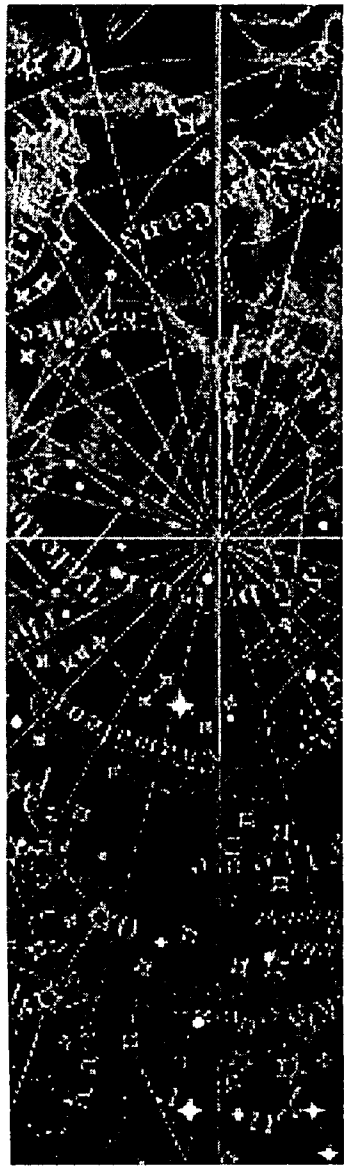

Good news #2:
Collaboration and interaction is easier

Bad news #2:
Controlling the interaction is harder

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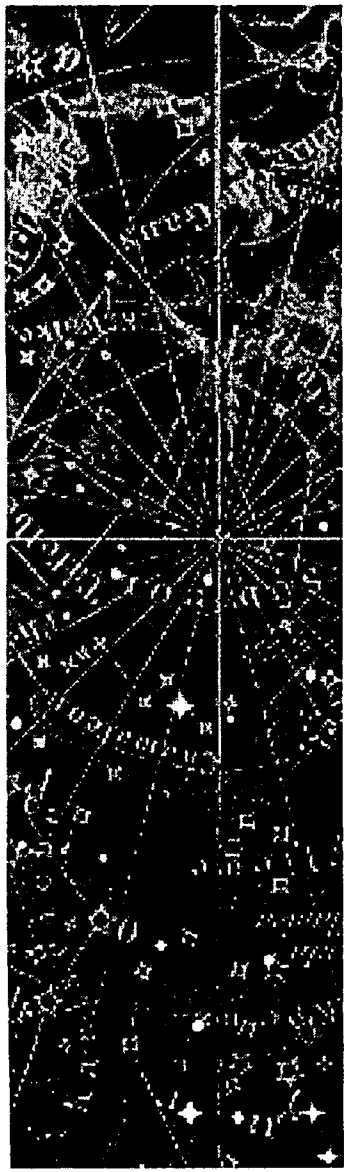

Good news #3:
Easier to leverage an expert

Bad news #3:
If we have the expert, do we still need teachers?

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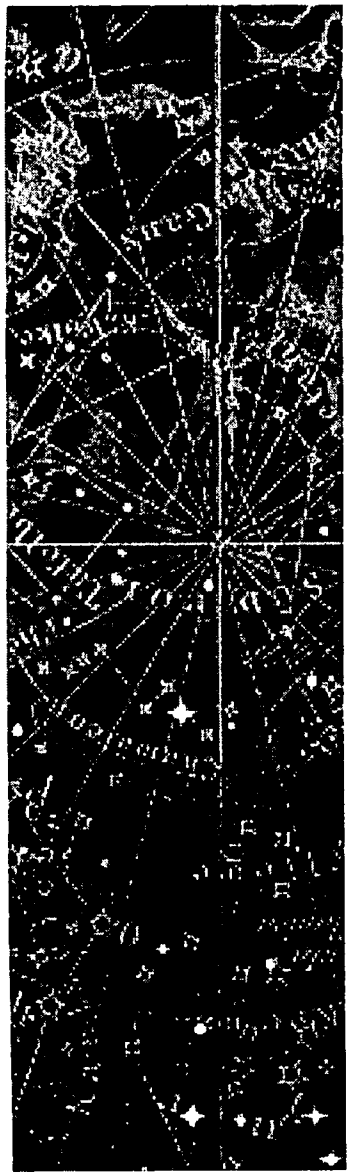

Good news #4:
Distinction between
teacher & learner blurs

Bad news #4:
Distinction between
teacher & learner blurs

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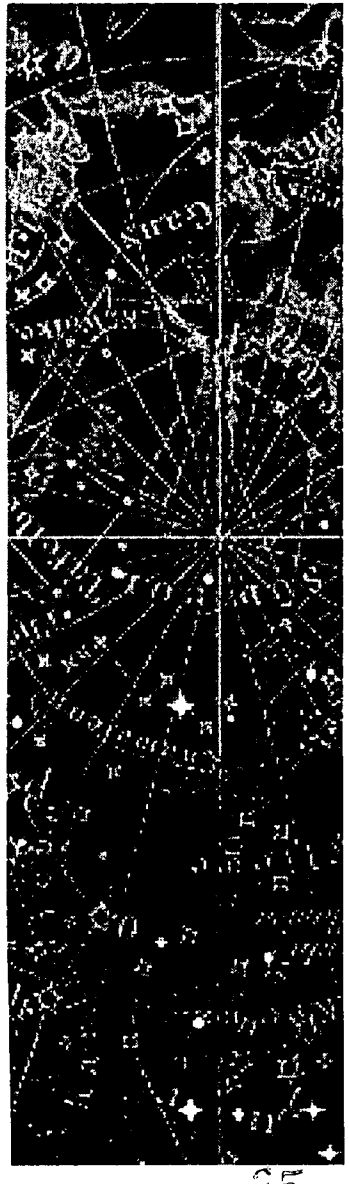

Good news #5:
Need less equipment to play lots of media

Bad news #5:
Play lots of media just because we can

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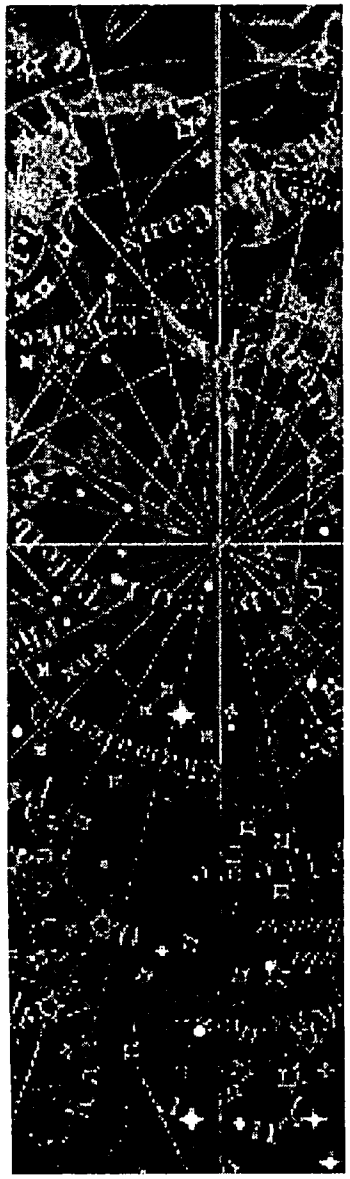

Good news #6:
Create lessons once, use many times (via URLs)

Bad news #6:
Tools to do this well require programming

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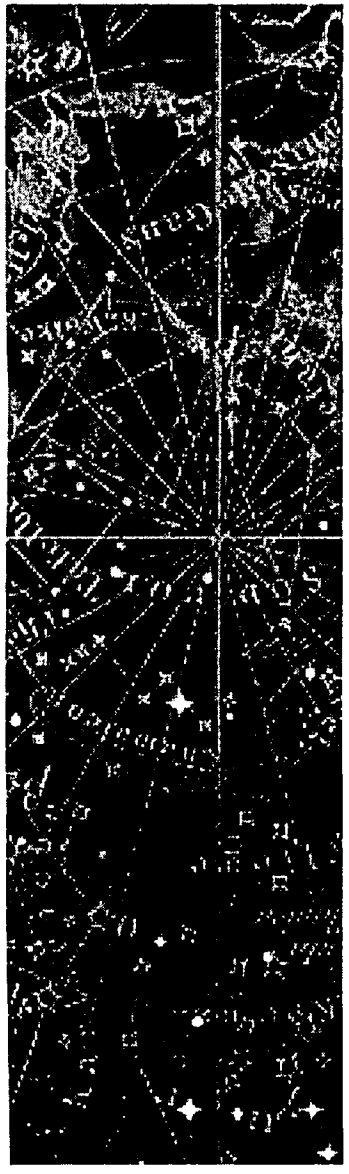

Good news #7:
300 million learners
are connected

Bad news #7:
4,700,000,000 aren't

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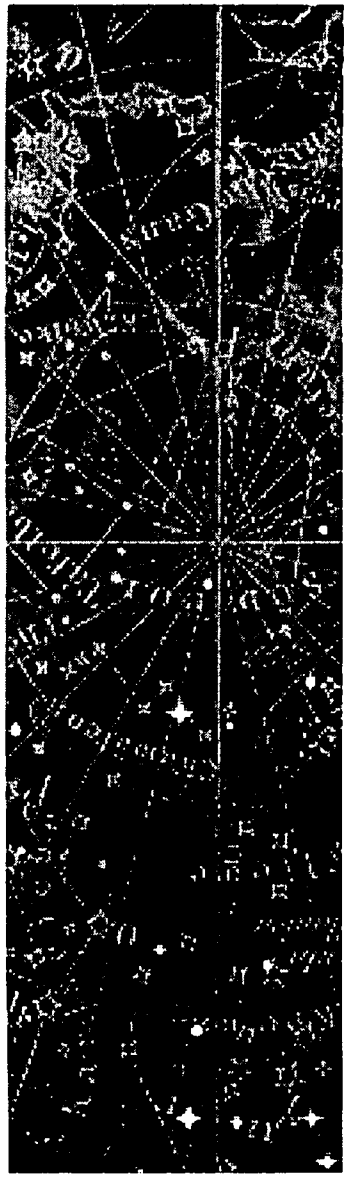
What education can do for the internet



Help make decisions about:

- Tell, show, let or ask
- Sequence what's presented
- Guide vs. browse

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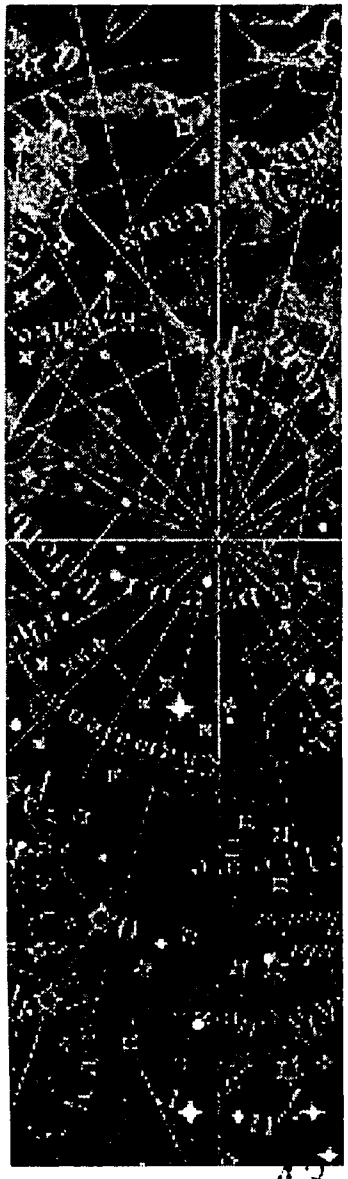
Fruitful Directions



- Learner contributes to content
- Conjoint design for learning and performance support
- Web support for classroom
- Make web pedagogy explicit

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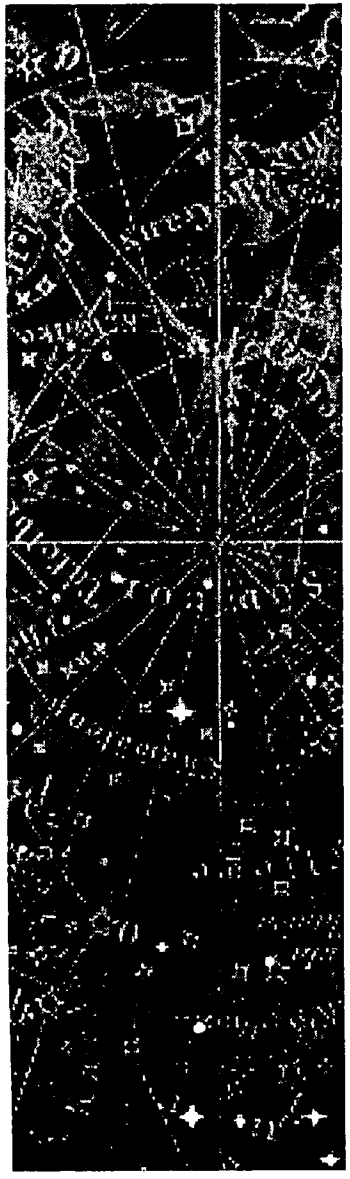
Final Plea #1



Don't just webify existing training

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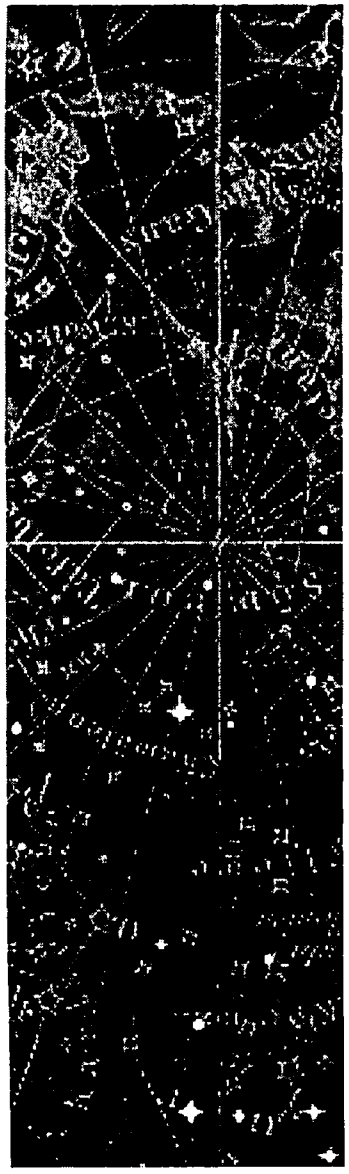
Final Plea #2



Instructional strategy and output FIRST, then tools

Table 1
Instructional Tactics

Classes of strategies are in **bold**.
Strategies are in *italics*.
Tactics are in plain text style.

1. Contextualizing instruction

1.1 Gaining the attention of the learner

1.1.1 arouse learner with novelty, uncertainty, surprise
1.1.2 pose question to learner
1.1.3 learner poses question to be answered by lesson

1.2 Relate the goals of instruction to the learner's needs

1.2.1 explain purpose or relevance of content
1.2.2 present goals for learner to select
1.2.3 ask learner to select own goals
1.2.4 have learner pose questions to answer

1.3 State the outcomes of instruction

1.3.1 describe required performance
1.3.2 describe criteria for standard performance
1.3.3 learner establishes criteria for standard performance

1.4 Present advance organizers

1.4.1 verbal expository: establish context for content
1.4.2 verbal comparative: relate to content familiar to learner
1.4.3 oral expository: establish context for instruction
1.4.4 oral comparative: relate to content familiar to learner
1.4.5 pictorial: show maps, globes, pictures, tables

1.5 Present structured overviews and organizers

1.5.1 outlines of content: verbal (see also 1.4.1, 1.4.2)
1.5.2 outlines of content: oral (see also 1.4.3, 1.4.4)
1.5.3 graphic organizers/overviews
1.5.4 combinations of verbal, oral, and pictorial overviews

1.6 Adapt context of instruction

1.6.1 content adapted to learner preferences (different situations)
1.6.2 content adapted to prior knowledge

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Table 1, Continued

2. Present and cue lesson content

2.1 Vary lesson unit size

2.1.1 large chunks
2.1.2 small chunks

2.2 Present vocabulary

2.2.1 present new terms plus definitions
2.2.2 student looks-up list of new terms
2.2.3 present attributes of rule definition, concept, principle
2.2.4 paraphrase definitions, present synonyms
2.2.5 present definitions
2.2.6 derive definitions from synonym list

2.3 Provide examples

2.3.1 prototypical examples
2.3.2 matched example/non-example pairs
2.3.3 divergent examples
2.3.4 close-in non-examples
2.3.5 vary the number of examples
2.3.6 model appropriate behavior

2.4 Use cueing systems

2.4.1 provide graphic cues: lines, colors, boxes, arrows, highlighting
2.4.2 provide oral cues: oral direction
2.4.3 provide auditory cues: stimulus change (e.g., music, sound effects, voice change)
2.4.4 provide type style cues: font changes, uppercase, type size, headings, hierarchical numbering system, indentation
2.4.5 present special information in windows

2.5 Advise learner

2.5.1 instructional support needed: number of examples, number of practice items, tools, materials, resources
2.5.2 learning strategies to use

3. Activating learner processing of instruction

3.1 Elicit learner activities

3.1.1 review prerequisite skills or knowledge
3.1.2 learner selects information sources
3.1.3 learner selects study methods
3.1.4 learner estimates task difficulty and time
3.1.5 learner monitors comprehension
3.1.6 learners relate questions to objectives
3.1.7 learners recall elaborations
3.1.8 learners evaluate meaningfulness of information

3.2 Elicit recall strategies

3.2.1 underline relevant material
3.2.2 rehearse/repeat/re-read
3.2.3 use mnemonic strategies
3.2.4 cloze reading activities
3.2.5 identification with location (loci method)
3.2.6 create summaries: hierarchical titles
3.2.7 create summaries: prose
3.2.8 create summaries: diagrammatic/symbolic (math)
3.2.9 create summaries: mind maps

3.3 Facilitate learner elaborations

3.3.1 imaging (creating images)
3.3.2 inferring from information
3.3.3 generating analogies
3.3.4 creating story lines: narrative description of information

3.4 Help learners integrate new knowledge

3.4.1 paraphrase content
3.4.2 use metaphors and learner generated metaphors
3.4.3 generating examples
3.4.4 note-taking

3.5 Help learners organize information

3.5.1 analysis of key ideas
3.5.2 create content outline
3.5.3 categorize elements
3.5.4 pattern note techniques
3.5.5 construct concept map
3.5.6 construct graphic organizers

4. Assessing learning

4.1 Provide feedback after practice

4.1.1 confirmatory, knowledge of correct response
4.1.2 corrective and remedial
4.1.3 informative feedback

4.1.4 analytical feedback
4.1.5 enrichment feedback
4.1.6 self-generated feedback

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Table 1, Continued

4.2 Provide practice

4.2.1 massed practice session
4.2.2 distributed practice session
4.2.3 overlearning
4.2.4 apply in real world or simulated situations (near transfer)
4.2.5 change context or circumstances (far transfer)
4.2.6 vary the number of practice items

4.3 Testing learning

4.3.1 pretest for prior knowledge
4.3.2 pretest for prerequisite knowledge or skills
4.3.3 pretest for endpoint knowledge or skills
4.3.4 embedded questions throughout instruction
4.3.5 objective referenced performance
4.3.6 normative referenced performance
4.3.7 incidental information, not objective referenced

5. Sequencing instructional events

5.1 Sequence instruction in logical order

5.1.1 deductive sequence (RULEG)
5.1.2 inductive sequence (EGRULE)
5.1.3 inductive sequence with practice (EGRULEG)

5.2 Sequence instruction in learning prerequisite order

5.2.1 hierarchical, prerequisite sequence
5.2.2 easy-to-difficult
5.2.3 concrete-to-abstract

5.3 Sequence instruction in procedural order

5.3.1 procedural, job sequence
5.3.2 information processing sequence (path sequencing)
5.3.3 algorithmic presentation
5.3.4 procedural elaboration

5.4 Sequence instruction according to content organization

5.4.1 general-to-detailed (progressive differentiation)
5.4.2 conceptual elaboration
5.4.3 theoretical elaboration

5.5 Sequence instruction according to story structure

5.5.1 narrative sequence

Valorie's Favorite Education URLs

A Few of the Coolest Education Web Sites
Web66: A list of k-12 resources
http://www.coled.umn.edu/

Maryland Public Television
http://www.mpt.org/numbers_alive

Genentech's "Access Excellence" site
http://www.gene.com/ae/

ThinkQuest's contest for educational uses of the Internet
http://io.advanced.org/thinkquest/

Tenth Planet (K12)
http://www.tenthplanet.com/home.html

Nova's Program on the Pyramids
http://www.pbs.org/wgbh/pages/nova/pyramid/

Hubble Space Telescope
http://oposite.stsci.edu/pubinfo/BestOfHST95.html

Northwestern University's "Learning Through Collaborative Visualization" Project
http://www.covis.nwu.edu

University of Colorado at Boulder's "Kids as Global Scientists" Project
http://www-kgs.colorado.edu

Sample School District Sites
North Carolina (nice looking site, links to lesson plans)
http://oaktree.dpi.state.nc.us/dpihome.html

Alberta Canada
http://ednet.edc.gov.ab.ca/

Cupertino Union School District
http://www.cupertino.k12.ca.us/

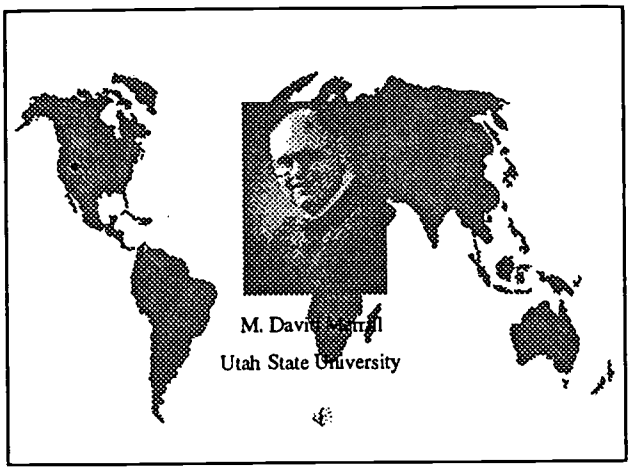
Maricopa Community Colleges
http://www.mcli.dist.maricopa.edu/

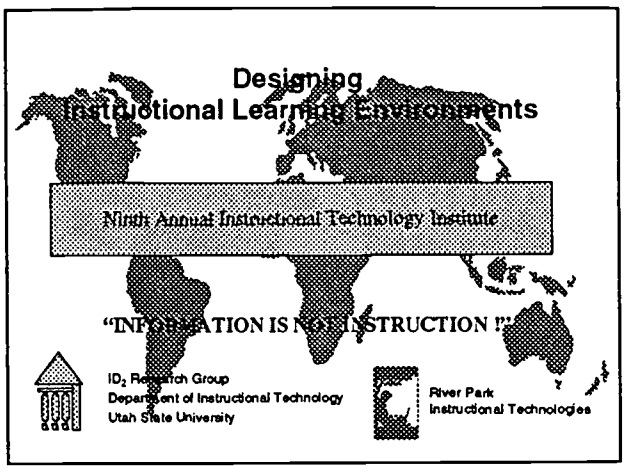
Educational Research Sites
Personal Learning Systems Initiative
http://ww2.readadp.com/PLS/

Utah State University ID2 Research Team
http://www.coe.usu.edu/it/id2/

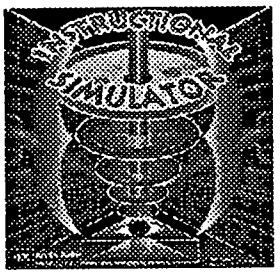
Intelligent Tutoring Systems
http://advlearn.lrdc.pitt.edu/its-arch/groups.html

Another good list of "favorite education urls" can be found at:
www.clp.berkeley.edu/CLP/education.html





Demonstration of the Instructional Simulator™



Instructional Learning Environments -- not just Learning Environments

- **Learner Guidance**
  - Explanation
  - Part identification with relevant practice
  - Progressive Practice not just simulation
    - Simon says "Click on the file menu"
    - Simon says "Do the next step"
    - You do it -- multiple paths to goal

ID_2 Instructional Learning Environments

TO LEARN MORE ABOUT

- **ID_2 Instructional Learning Environments**
  Visit www.riverpark.com

- **ID2 Instructional Design Theory**
  Visit www.coe.usu.edu/coe/id2

Knowledge Objects for Learning Environments

- Knowledge objects are containers consisting of compartments for different related elements of knowledge.
- The framework of a knowledge object is the same for a wide variety of different topics.
- The contents of a given knowledge compartment differ, but the compartments stay the same.

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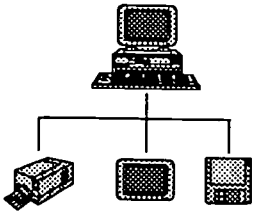
Kinds of Knowledge Objects

- Entities
  - Device, object, person, creature, place, symbol
- Activities
  - Steps performed by the learner on some entity.
- Processes
  - Events that occur in the world that change the properties of an entity, often triggered by an activity.

Components of Knowledge Objects

- Parts of Entities
  - parts of parts
- Steps of Activities
  - steps of steps
- Events of Processes
  - events of events



Properties of Knowledge Objects

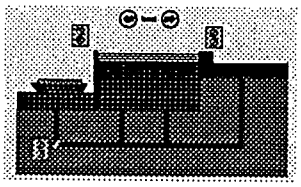
- **A property is a quality or quantity describing an entity.**
- **Properties have values.**
- **Each value is assocated with a portrayal or indicator.**

Property	value
display type	= super vga
display density	= 640 x 480
screen size	= 17 inches

Elements of Knowledge Objects for Learning Environments

- Name
- More information
  - categories of information
  - each represented by configuration of media
- Portrayal -- graphic representation of entity
- Properties -- qualities or quantities
- Actions -- performed on or with the object
- Processes -- changes in property values of its owner or other entities.

Elements of a property



- **Name -- lock position of canal boat**
- **Legal values -- below, in, above**
- **Current value -- below**
- **Indicator (portrayal)**
  - **position on animation grove**

Elements of an Action

- An action is a trigger for a process
  - Push lower gate opener (controller)
    part of the entity canal lock
  - Trigger -- process open of lower gate

yellow = action
grey = entities
red = process

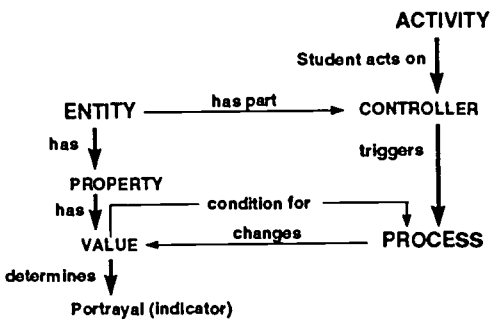
Elements of a process

- Consequence **(can have more than one)**
  - a change in the value of the property of an entity
- Condition **(can have more than one)**
  - a value on the property of an entity
- Feedback **(can have more than one)**
  - any media, combination of media or an external program displayed when a process executes
- Trigger **(can have more than one)**
  - a message to another process to execute

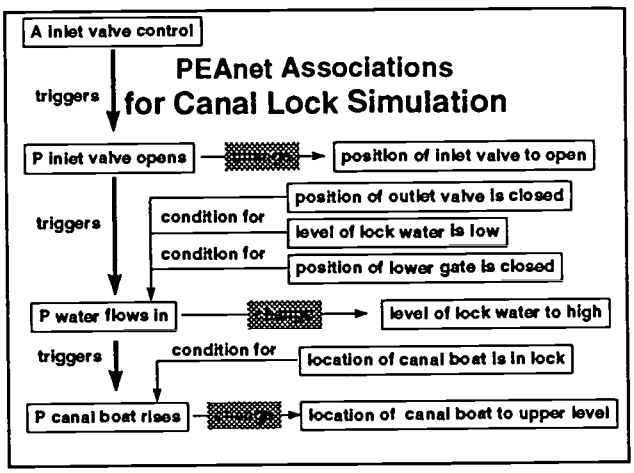
Canal lock entities

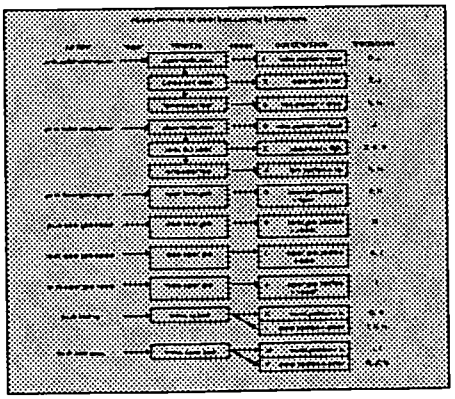
outlet valve	position	open, closed
upper gate	position	open, closed
lower gate	position	open, closed
lock water	level	high, low
canal boat	canal position lock position	below, in, above up, down

PEAnet Associations for Knowledge Objects

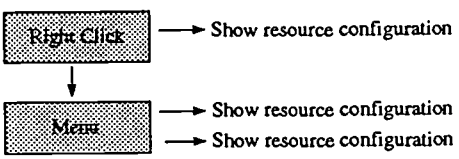


PEAnet Associations for Canal Lock Simulation





How does More Information work?



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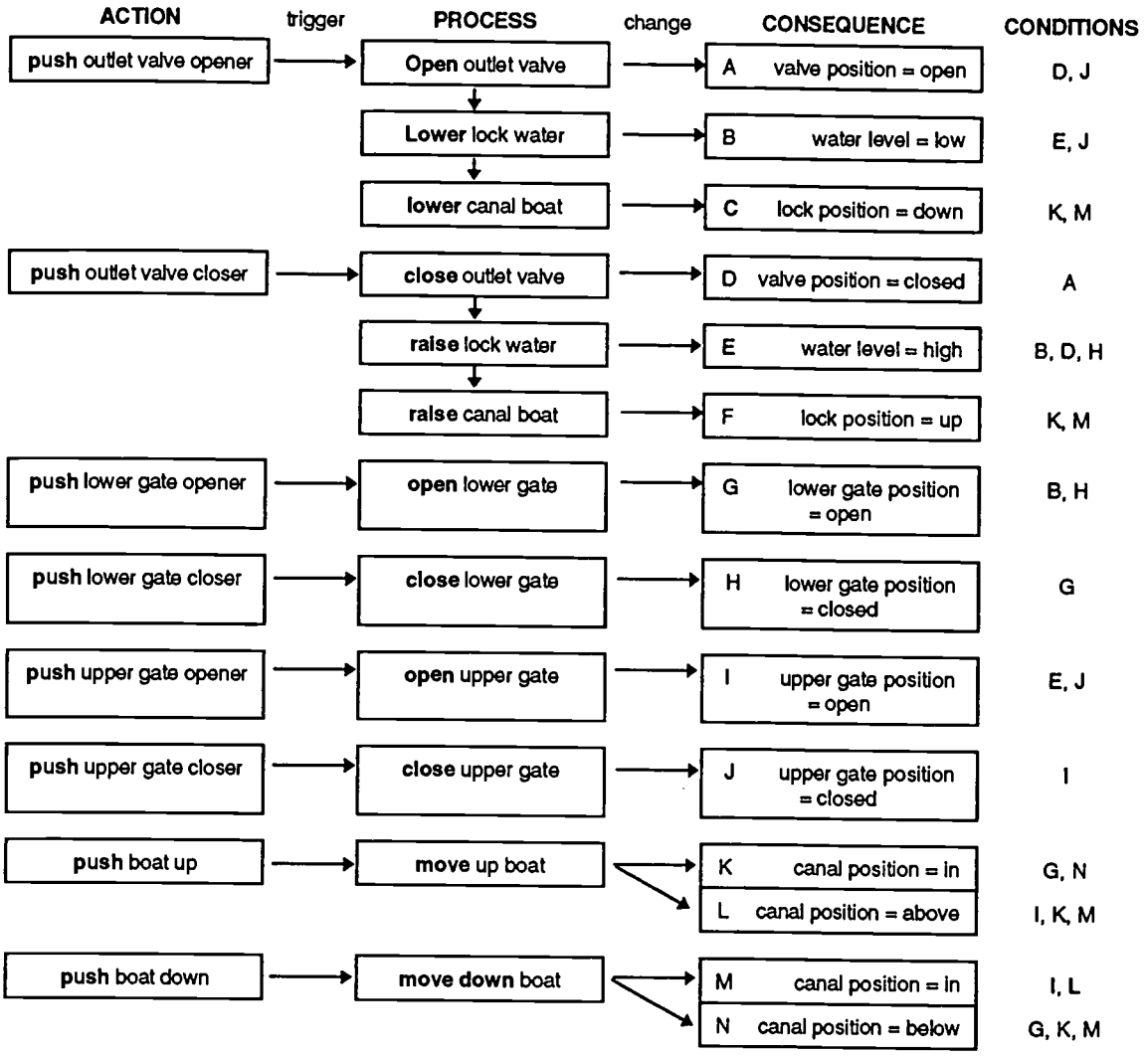
PEAnet structure for Canal Boat Learning Environment



How does a lecture work?

- Click guide for lecture -- list of entities and information type.
- System highlights entity from list.
- System shows more information of information type.

There can be as many different lectures as required.
Each lecture can include the same or different entities.
Each lecture can include the same or different information types.

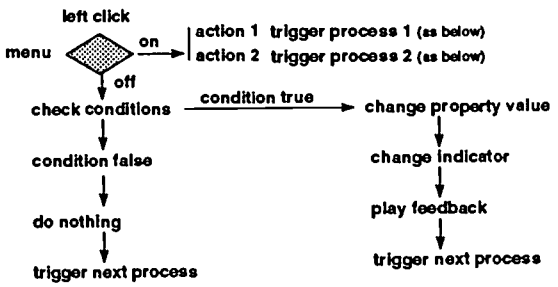
How does identify names work?

- Highlight entity from list.
- Provide list of names.
- S selects correct name from list.
- If right next entity from the list.
- If wrong a message and correct name is provided.

How does location identify work?

- Provide a name from the list.
- S clicks on the corresponding entity.
- If correct the next name is provided.
- If wrong the correct entity is highlighted.

How does simulation engine work?



How does explain work?

- Explain provides a what and why statement.
- What states the consequence. If more than one process then the consequence of each.
- Why states the conditions which were met or which failed to be met for each process.

Action: push lower gate opener
What: nothing happens
Why: because water level is not low (B failed)

How does inference engine work?

- Goal:
  canal position = below
- Initial state:
  upper gate = open
  water level = high
  canal position = in
  lock position = up
  lower gate = closed
  outlet valve = closed

- Is canal position below? no
  then 4 push boat down.
- Is lower gate open? no
  then 3 push lower gate opener.
- Is canal position in? yes
- Is whater level low? no
  then 2 push outlet valve opener.
- Is lower gate closed? yes
- Is valve position closed? yes
- Is upper gate closed? no
  then 1 push upper gate closer.
- Is upper gate open? yes

Steps are numbered in reverse order after inference engine has finished its work.

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How does Simon says demo work?

- Inference engine determines sequence of steps.
- System provides message:
  Do <name of action>.
- If S does step, system presents message for next.
- If S does not, system provides message:
  That is not <name of action>.
- Do the next step works the same except system merely provides message: "Do the next step." rather than the name of the step.

How does perform work?

- The simulation engine is in operation.
- A record keeping system records each step taken by the student.
- When S checks "finished" the system compares the students steps with the steps generated by the inference engine. S is informed if his performance included the correct solution.
- S's performance is compared with the steps of the inference engine and unecessary steps are highlighted.

How will predict work?

- The sytem sets up a problem
  A problem is an initial state of the conditions.
- S is asked to predict whether a given process or sequence of processes will execute.
- S is asked to indicate why the process will execute or why it will not execute. This is done by selecting those conditions which are satisified or which failed to be satisified.

How will troubleshooting work?

- The system sets up a problem by setting the initial conditions and inserting one or more failed conditions. A failed condition is one which does not work correctly.
- S runs the simulation.
- S is asked to trace the conditions to find the faulted condition(s).

Summary

- **Knowledge objects which include properties and linked actions and properties make possible:**
- **Exploratory learning environments**
- **Learner guidance consisting of:**
  - **lectures**
  - **identify practice**
  - **explain**
  - **Simon says demonstrations**
  - **Performance assessment**
  - **Prediction**
  - **Trouble shooting**

How can I get the Instructional Simulator™?

The Instructional Simulator is available as a commercial product from River Park Instructional Technologies L.C.

(801) 752-9580
Fax (801) 797-3851
Email: mcknight@cc.usu.edu
http://www.riverpark.com

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Discussion Paper Series

A Frame of Reference:
NETG's Map to Its Products, Their Structures and Core Beliefs

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National Education Training Group, Inc.
1751 W. Diehl Road
Naperville, Illinois 60563
April 1997

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"We can't see the trees because of the forest." This rephrasing of an old adage illustrates a problem with perspective which can often occur when looking at complex systems whose basic structure is hidden in the complexity of the structure itself. This limited perspective results in a misunderstanding of how the system actually works and encourages conceptual limitations on how the system can be used. In the example, the "forest" becomes the only structure possible when you do not understand the "trees". Likewise, NETG's vast range of products cannot be used to their greatest potential if their basic structure and development are not completely understood.

Today, NETG has a variety of products: Multimedia CD ROM, LAN CDs, LOD, Active Content, SkillVantage® Manager, PathFinder, Spotlight and more. In the future, Learning Objects™ and Performance Support Systems (PSS) will deliver instruction in an almost unlimited combination. However, this same variety and complexity also presents the danger of confusion and limitation of use if not grounded in an understanding of the basic underlying concepts and rules used to develop these products.

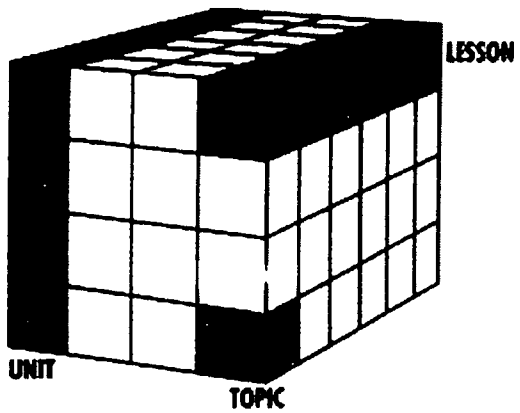
In order to effectively use the ever increasing variety of NETG's products, it is important to understand their underlying concepts, rules and basic structures. That is the primary purpose of this paper. In addition, this paper will provide a map of proposed improvements to these basic structures that takes advantage of current and future research in instructional design. Finally, this paper will promote a dialogue with NETG's clients to help imagine new product configurations which will meet the customers' new and emerging training needs.

In order to understand NETG's products and their structures, one must begin with our core belief: "If our products do not teach, they have no value." We believe instructional integrity can be reached through the application of the best practices of instructional design. Inherent in this philosophy is the promise that our products will teach the intended skill, as well as provide a verification that learning has taken place by using valid assessments. The ability of NETG's products to meet critical client expectations is the criteria against which we measure success. While we also pay strict attention to content accuracy, interface design, graphics and distribution technology, these are only contributors to the ultimate goal of providing learners with direct and verifiable learning experiences.

In order to achieve our goal - the instructional integrity of NETG's products - the best practices of instructional design must be applied to their development. However, before these instructional design practices are outlined, the structures within Skill Builder™ must be completely understood. Once explained, it will be easier to describe how these structures were shaped by effective and proven instructional design practices.

Initially, it is easiest to see a Skill Builder course structure as a matrix (Figure 1) divided into three major components: units (the vertical), lessons (the horizontal) and the topic (the cell).

Figure 1



Each unit, lesson and topic in this structure is defined, in part, by its relationship to the other components.

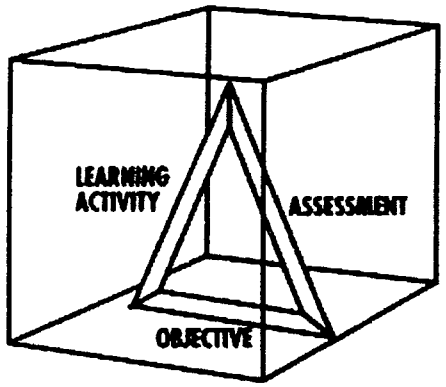
1. Course: Made up of independent units
2. Unit: Made up of independent lessons
3. Lesson: Made up of independent topics
4. Topic: Independent objects that contain a single objective, a learning activity and an assessment

It is important to note that each component is independent. In other words, as an instructional experience, each can stand on its own and is not dependent upon other structures for its meaning or context. This is an important feature that will be discussed again in the section on modularity.

At its lowest level of granularity, the topic is our basic structure and is represented in our matrix as a cell. Because it is the base component of all courses, units and lessons and can be used to create other unique structures, we call it the Learning Object structural component, which is defined as the smallest independent instructional experience that contains an objective, a learning activity and an assessment. Its specific elements are outlined in Figure 2.

Figure 2

THE ELEMENTS OF THE LEARNING OBJECT™



Each element of the Learning Object structural component (a.k.a. "topic") has a specific definition.

1. Objective: An element of a Learning Object structural component that is a statement describing the intended criterion-based result of a learning activity

2. Learning Activity: An element of a Learning Object structural component that teaches to an objective

3. Assessment: An element of a Learning Object structural component that determines if an objective has been met

As the basic component structure in a Skill Builder, the Learning Object structural component and its elements are the focus of our instructional design efforts. In other words, the instructional integrity of Skill Builder starts with this basic building block.

In his paper "Reclaiming Instructional Design", Dr. M. David Merrill of Utah State University offers the following definition.

> The technology of instructional design is founded on scientific principles verified by empirical data. Like other sciences, instruction is verified by discovery and instructional design is extended by invention. Instructional design is (also) a technology which incorporates known and verified learning strategies into instructional experiences which make the acquisition of knowledge and skill more efficient, effective, and appealing. (Merrill, 1996)

These scientific principles, verified through empirical data, form the basis of the best practices that are used by NETG within the Learning Object structural component and its elements.

OBJECTIVE

An objective is a statement that describes the intended criterion-based result of instruction. This end result must be specific and measurable in order to determine if the desired criterion has been met. In other words, a well-stated objective must be clear about what the learner is going to be able to do, under what conditions it is to be done and how well the learner must perform under these conditions, i.e., a measurable criterion. The protocols used for stating objectives are from the research of Dr. Robert Mager.

At the topic or Learning Object structural component level, objectives are called Enabling Objectives, since they lead to broader lesson goals or Terminal Objectives. For the purpose of staying focused on the Learning Object structural component, we will concern ourselves with Enabling Objectives only. Examples of topic-level Enabling Objectives are:

1. Given a bad line of C++ code, the learner will be able to correct its syntax error in three attempts.
2. Presented with a sample of unformatted text within Word for Windows, the learner will be able to correctly apply five of the six styles from the Format menu.
3. Presented with a sample toolbar of ten buttons within Excel, the learner will be able to correctly identify the functionality of at least nine buttons.

LEARNING ACTIVITY

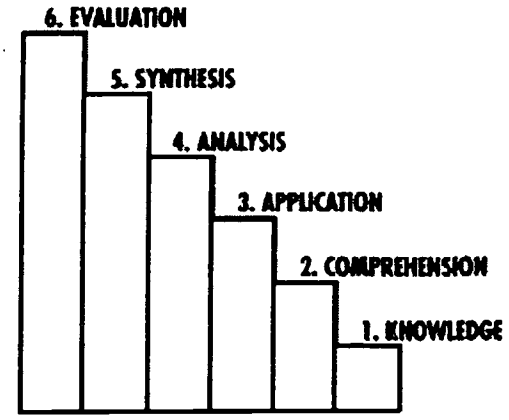
After formulating a well stated objective, the next step is to determine the best way to teach it. For example, Objective No. 2 is asking for a learning activity in which the learner is actually going to format some text.

Consequently, to achieve this objective, the learner will need a direct experience either with the word processing software or a simulation. On the other hand, Objective No. 3 is asking for simple identification. In this case, the learning activity could possibly be having the learner match an icon on a toolbar with its functional description.

The selection of the best way to teach to an objective is not governed by chance but by Dr. Benjamin Bloom's Taxonomy. Bloom's Taxonomy is a continuum of cognitive complexity that allows the developer to determine the appropriate way to teach to the stated objective (i.e., the learning activity).

Figure 3

BLOOM'S TAXONOMY



The developer can determine the Bloom level by looking at the end goal of the objective and the verbs used to describe it. For example, examine Objective No. 2, "Presented with a sample of unformatted text in Word for Windows, the learner will be able to correctly apply five of the six styles from the 'Format' menu". The outcome is for the learner to actually do a formatting task, and the verb used in the instructional objective is apply. This combination would indicate a Bloom Level 3 (Application).

The proper way to teach this, within the context of a Skill Builder, is to build a simulation of the formatting function and set up a formatting task. Asking the learner to name or list formatting functions (Bloom Level 1, Knowledge) or to identify the pull-down menu under which Fonts would be found (Bloom Level 2, Comprehension) would be inappropriate ways to teach this objective.

Skill Builder, as its name implies, primarily teaches the skills necessary to operate complex application software; consequently, many of the learning activities are at a Bloom Level 3 (Application). Because of this characteristic, Skill Builder tends to have a high proportion of simulations.

Not only must the learning activity be appropriate to the task, it also must engage the learner. Most multimedia instruction tends to focus only on cognitive tasks, with little or no consideration of the motivational aspect of

what is to be learned. In our judgment, if the learner cannot see a direct and personal value in what is being learned, the learning will be rejected as not relevant. In order to make sure that the learner is engaged on a personal level and sees value in the instruction as it applies to their job, NETG uses Dr. John Keller's ARCS model.

Figure 4

THE ARCS MODEL

Attention	• Gain and maintain learner attention through novel events
	• Stimulate information-seeking behavior
	• Vary the elements of instruction
Relevance	• Use concrete language and real-world examples
	• State the goal for the instruction
Confidence	• Make learners aware of performance criteria
	• Provide multiple achievement levels
	• Provide feedback against criteria
Satisfaction	• Provide opportunities to use newly acquired knowledge or skills
	• Provide feedback
	• Maintain consistent standards and consequences for task accomplishments

After the proper Bloom level has been determined, the developer uses the various aspects of the ARCS model to ensure that the learning activity gains the learner's attention, uses real-world examples, provides an awareness of performance criteria, gives feedback, and provides opportunities for applying newly acquired knowledge or skills. By consistently applying this research-based model, the fundamental question "What's in it for me?" is addressed.

As another refinement of its learning activities, NETG applies a presentation model based on the work of Dr. M. David Merrill. For each of the categories of content listed in Figure 5, the following components are presented to the learner, in accordance with Dr. Merrill's research on effective presentation: Content Presentation, Practice and Assessment. NETG has added one content category to Dr. Merrill's four original categories.

Figure 5

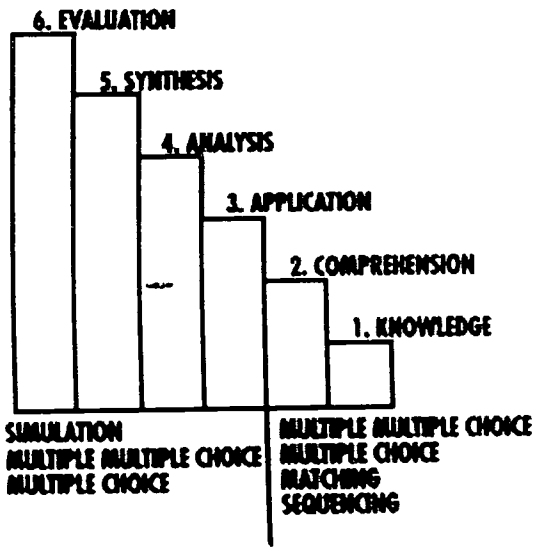
NETG DISPLAY MODEL BASED UPON DR. M. DAVID MERRILL'S RESEARCH ON EFFECTIVE PRESENTATION

Content Categories	Content Presentation		Practice	Assessment
	What	How		
Information About...and Parts of... (Facts, Information, etc.)	General Information Features, Functions, Definitions	Didactic presentation Exploratory learning	Identify, label or recognize information	Restate or reproduce information
Kinds of... (Concepts, Relationships, etc.)	Definitions: Attributes, characteristics, functions or use Rules of relationship Relationship(s) to other concepts Examples and non-examples with differences highlighted and explained	Didactic or expository presentation Exploratory learning Examples and non-examples	Identify examples and non-examples Distinguish differentiating characteristics	Identify previously unencountered examples of concepts
How does it work... (Process)	Process parts and elements: components, steps, functional outcomes, conditions and requirements	Explanation or demonstration of process Exploratory learning	Reproduce process flow Reproduce or identify the components or outcomes of the process Link components with functions or outcomes Link outcomes with functions	Reproduce outcomes and/or process flow with new or un-encountered examples or situations
How do you do..., How is it done... (Procedures, Task)	Rules Purpose of procedures Steps	Expository or guided demonstration of procedures	Perform in new context with varying degrees of guidance and/or help	Perform procedure in previously unencountered context without assistance
What is the general rule... (Principles)	Definition of rules Application heuristics	Explanation of rule or principles (how applied, when to use) Examples and non-examples	Apply rules to new situations Identifying outcomes, conditions, and relationships based on the rules	Identify conditions responsible for outcomes Predict results based on conditions Apply rules in new contexts

ASSESSMENTS The final element of the Learning Object structural component is the litmus test that determines whether or not an objective has been met—the assessment. Here, the rule is very simple. Just as you would teach or set up a learning activity, so also should you assess. Again, consider Objective No. 2, "Presented with a sample of unformatted text in Word for Windows, the learner will be able to correctly apply five of the six styles from the Format menu". The outcome is for the learner to actually do a formatting task, and the verb used in the instructional objective is apply. The appropriate way to teach to this Bloom Level 3 (Application) objective is by creating a simulation. Consequently, to create an appropriate assessment, a Bloom Level 3 would also demand that this skill be assessed through the use of a simulation. Conversely, an inappropriate way to assess this objective would be to use a multiple choice, matching or sequencing item.

Figure 6

ASSESSMENT TYPES MAPPED TO BLOOM'S TAXONOMY



Skill Builder has five types of assessments. These are: Multiple Multiple Choice (more than one correct response), Multiple Choice (one correct response), Matching, Sequencing and Simulation. Figure 5 shows how these assessment types map to Bloom levels.

Finally, in order to ensure that we are testing for skills and knowledge and not testing someone's test-taking ability, all assessment items are drawn from a random pool of items. In addition, the position of any correct answer and associated wrong answers are also randomized, thereby ensuring a low probability that the learner will get exactly the same assessment item on each potential retake.

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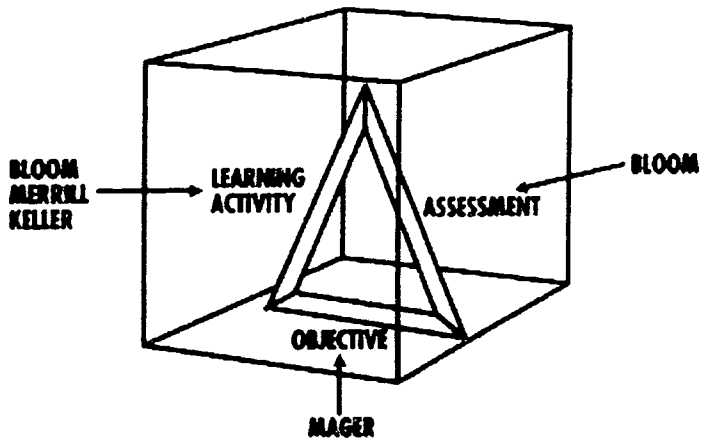
As stated at the beginning of this paper, the key to maintaining the instructional integrity of our products is the application of the best practices of instructional design. All of these best practices are focused on the Learning Object structural component, since it is the basic component that can make up a variety of structures.

Figure 7

NETG'S RESEARCH FOCUS



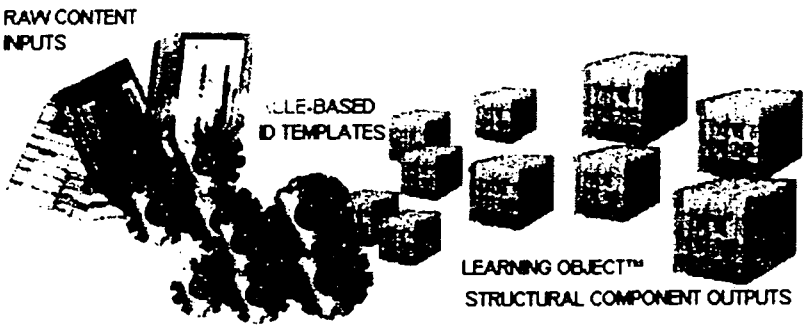
The idea of this focus is simple. If the value of NETG's products is its ability to teach skills as well as verify that they have been learned, and the key to this value is the application of the best practices of instructional design, it follows that all other structures consisting of the Learning Object would contain a high degree of instructional integrity.

MANUFACTURING THE LEARNING OBJECT™ STRUCTURAL COMPONENT

In order to ensure the instructional integrity of the Learning Object structural component, NETG has developed a manufacturing environment that embodies the best practices of instructional design. This templated environment uses a rule-based system that walks the developer through a series of automated steps that turns raw content into multimedia instruction.

Figure 8

NETG'S MANUFACTURING ENVIRONMENT



Through an automated design and scripting technology, the developer is aided in the creation of the unit, lesson and topic structure. Next, the system prompts the developer to articulate the instructional objectives at the lesson and topic level. Through an analysis of the verbs and outcome of the instructional objective, the developer is assisted in assigning a Bloom level to the objective. Once the Bloom level has been assigned, the appropriate mastery assessment items are created for the assessment item pool. Again, using Bloom, as well as Merrill, the developer outlines the specific and appropriate learning activity needed to teach to the objective.

Within this engine, the instructional design rule-base comes into play when the developer is at a critical decision point. For example, if an objective has been assigned a Bloom Level 3 (Application) and the developer wishes to create a multiple choice item to assess it, the system advises the developer that this type of item is inappropriate and that a simulation item would be a better assessment choice. A similar advisement would come into play if the developer wishes to construct a learning activity that would consist of a didactic presentation for this same objective. Again, because a Bloom Level 3 requires active participation in order to teach the application of a skill, the developer would be forced into describing a simulation as the basis for the learning activity.

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Through the use of this rule-based manufacturing process, the instructional integrity of each Learning Object structural component is assured and variance across different developers reduced. The end result is an instructionally sound and uniform component that can be combined with other components to create a variety of other structures that all have the same degree of integrity.

THE LEARNING OBJECT™ STRUCTURAL COMPONENT: A FOCAL POINT FOR PRODUCT IMPROVEMENT

Any product or product component must always remain open to continuous improvement. The Learning Object structural component provides NETG with a focus for improvement. From an instructional integrity perspective, this focus will always be concerned with improving the three elements that make up the Learning Object structural component. It is our desire to continue to improve our instructional objectives and their linkage to job competencies; the creation of better and more dynamic learning activities for better retention of information, concepts and skills; and the development of improved assessments that predict mastery of vendor certification exams. This focus has already yielded the following innovations:

Objective:	1. The combined use of Mager's protocols for articulating specific instructional objectives and Bloom's Taxonomy for determining appropriate learning activities and assessment items. 2. The creation of a set of rule-based design templates to ensure that the Mager and Bloom models are appropriately applied.
Learning Activity:	1. Combining Mager's instructional objectives and Bloom-appropriate learning activities with Keller's ARCS model in order to enhance both the efficiency and motivational aspects of the learning activity. 2. The extensive use of simulations, since a high proportion of our learning activities are Bloom Level 3 (Application) and above.

Assessment:

1. The combined use of Mager's protocols for articulating specific instructional objectives and Bloom's Taxonomy for determining appropriate assessment types.
2. The creation of assessment items via a test creation tool that builds an assessment pool out of which the learner draws random assessment items.
3. The creation of assessment items that are not only presented from a random pool of items, but where the distracters (incorrect answers), the order of the correct answers and the sequence of test items are also randomized.
4. The unique use of simulations as an assessment item type for Bloom Levels 1-4.
5. Precision Learning™. The use of a preassessment to account for the learner's prior knowledge of a topic; and, based upon this preassessment, to provide an individualized path for the learner on those topics with which he/she is not familiar.

In order to continue to add to this list of innovations, the following improvements to the three elements of the Learning Object structural component are planned.

Objective	1. The creation of higher level objectives at the unit, course and series level in order to link specific instruction to competency-based job descriptions. 2. Improvements to our design tools that allow an even higher degree of accuracy in developing objectives at any level.
Learning Activity:	1. The development of a new practice model for Bloom Level 3 (Application) that allows the learner to see the sequence of a software operation demonstrated (Show Me), is guided in the execution of the sequence (Guide Me) and is left on his/her own to do the sequence without any assistance (Let Me Do It). 2. The development of other new models for the more effective presentation of Bloom Level 1 (Knowledge) and Level 2 (Comprehension) information and concepts, as well as the exploration of a new model for Bloom Level 4 (Analysis). 3. The exploration of the use of learning activities and the tools that create them as elements in a Performance Support System (PSS). 4. Continued research between the use of effective, high quality graphics and their relationship to effective learning, and the application of these findings to improving our learning activities.
Assessment:	1. The incorporation of the Let Me Do It component of the new practice model into the simulation assessment item, thereby providing a more realistic simulation of the actual software. 2. Conducting research in order to determine the relationship between Skill Builder postassessment scores and passing scores on various certification exams. The purpose of this research is to continue to build products that prepare learners for certification.

SUMMARY AND AN INVITATION TO A DIALOGUE

At the beginning of this paper, three purposes were stated. Our first objective was to help the reader determine a more effective use of the ever increasing variety of NETG's products by removing any potential confusion caused by their complexity. The second purpose was to provide a map of proposed enhancements to the basic elements that make up the Learning Object. Through an understanding of this core structure, the final purpose of this paper was to promote a dialogue with our clients to help us imagine new product configurations to meet their new and emerging training needs.

NETG has developed a very powerful concept in the Learning Object structural component; but, like all components, the related structures and deployment systems are seemingly infinite. In the face of this variety, these structure must be focused on meeting the specific needs of our new and existing clients. We at NETG need to know if the structures and direction stated in this paper provide you with the options necessary to meet the specific training problems that you face in your organization. Are the options there; and, if not, what do we have to do to be better aligned?

This, then, is an invitation to a dialogue. Through this dialogue, we will continue to grow this powerful concept of the Learning Object in a direction that will continue to meet your training needs, both now and into the future. Please send your responses and suggestions to me at the following address:

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National Education and Training Group
1751 W. Diehl Road
Naperville, IL 60563
or email me at dtcjlal@pd.netg.com

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Computer Managed Instruction

The Inevitability Of CMI In
Technology-Based Training

Kevin Oakes, President
Oakes Interactive Incorporated

Dick Walker, Sr. Consultant
TopShelf Multimedia

Agenda

- CMI definition, features & benefits
- Problems integrating CMI
- CMI standards
- The future of CMI
- The best CMI tool available today

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Who is Oakes Interactive?

- 60+ Custom Multimedia Training Developer
- 5 Years Old
- Considered one of the top multimedia training development firms in nation
- A family of synergistic companies

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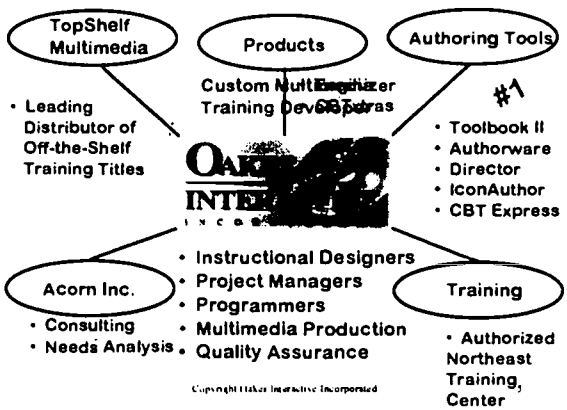

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TopShelf Multimedia Overview

- Offering top off-the-shelf titles on market today
- Target Market
  - Fortune 1,000
  - Consultative Sell
  - Organizations with a technology infrastructure in place today to support technology based training today

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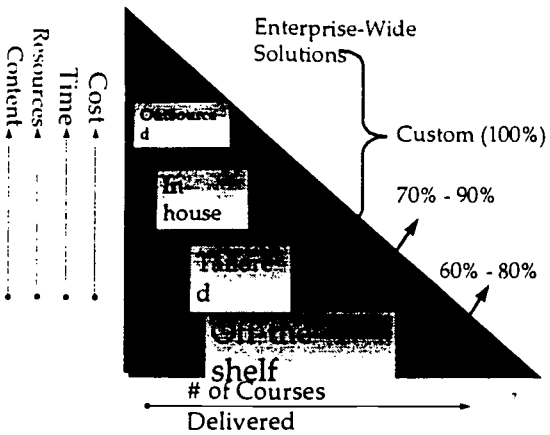

The CBT/CMI Landscape

- Companies using more & more off-the-shelf CBT / integrated with custom courses
- 71% of companies using or will use intranet-based training
- Need to manage courses & students across the enterprise
- CMI will be as common as CBT

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Definition

CMI -

Computer Managed Instruction

"The ability to manage the data of multiple users in a computer-based learning environment across the enterprise"

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Definition

CMI -

Computer Managed Instruction

"The ***Operating System*** for technology-based training"

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Features of CMI

- Student registration
- Student records
- Testing
- Reporting
- Administration

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Benefits of CMI

- Benefits to the learner
  - Ease of sign-on for multiple courses
  - Use any terminal
  - Knowledge of progress
  - Track multiple courses
  - Communicate to administration and instructor

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Benefits of CMI

- Benefits to administrator
  - Track individual student progress
  - Track groups
  - Assign courses
  - Receive feedback from learners
  - Provide security of courses

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Benefits of CMI

- Benefits to enterprise
  - Know what is happening to the training $$
  - Rapid dissemination of information
  - Ties company together
  - Integrates better with EPSS

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Benefits of CMI

- If you are not measuring it, how do you know
- For the first time, you can measure the ROI

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Historical Management Problems

- Lack of CMI standards in the past
- Different ways to distribute data:
  - LAN
  - Sneaker Net / Diskette
  - Internet / Intranet
- Desire to collect data from one location
- Difficult to link courses and databases

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Historical Management Problems

- Each CBT title has its own CMI version
- Existing generic titles don't have common internal structures: no common API's
- There are no standard pre or post test structures
- There are no data collection or reporting standards

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Historical Management Problems

- A critical mass of titles is not offered from any one publisher
- There are few methods for rapidly developing company specific information to accompany off-the-shelf titles
- There are no methods for mixing of lessons from multiple titles from different vendors

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AICC Standards for Training Mgt.

- Boeing
- Airbus
- McDonnell Douglas
- Pratt & Whitney
- United Airlines
- Lufthansa
- Honeywell
- Federal Aviation Admin.
- Swedish Air Force
- Air Canada
- Delta Airlines

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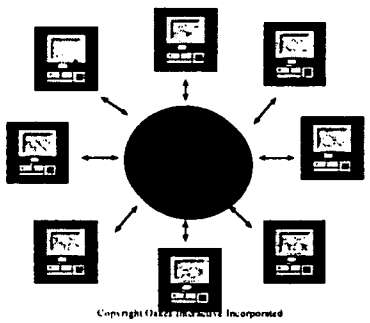
AICC Standards For Course Mgt.



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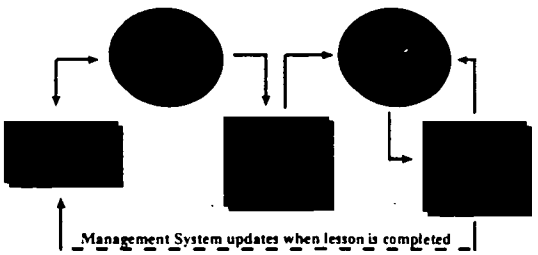
AICC Standards For Course Mgt.



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Realities of Implementation

- CBT moving toward Intra/Internet
- Internet not ready for fat content
- Internet not ready for sophisticated interactions or highly complex branching
- Most intranets not ready for fat content
- Most companies don't have sound cards
- Hybrid solution is the best solution today

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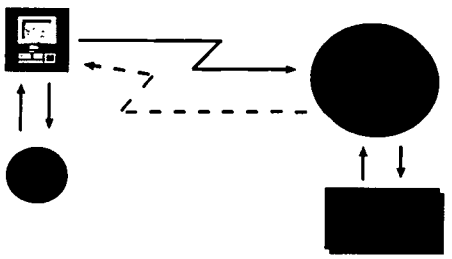
Today's Learning Organizations



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Reality Today / Reality Tomorrow

- CMI is the most talked about, least implemented function in CBT
- To be true learning organizations, without buying from one content provider, a CMI tool needs to be present
- Corporate intranets / the Internet will help CMI become ubiquitous

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Opportunity As We See It

- Provide companies not only the best off-the-shelf training titles available, but also the ability to manage them
- To offer the top 100 titles under a common CMI environment
- Also to incorporate existing custom CBT
- To roll out the following :

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Phased Development Phase I

- Intranet & Internet management of courseware
- Simple CMI functions
  - Assign courses
  - Track completion & total time
- Multiple courses
- Manage single users

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Phased Development Phase II

- Complex CMI data
- CMI common interface
- Parts of courses
- Establish groups
- E-mail and chat rooms

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Phased Development Phase III

- Pay by use option
- Task analysis tools integrated
- Complex CMI functions
- CMI managed externally

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The Best CMI Solution Today?

TOOLBOOK II
LIBRARIAN

The World's Most Powerful Solution for Managing Internet-Based Distributed Learning

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ToolBook II Librarian

- Runs with a Web Server
  - Windows NT
  - Solaris UNIX
- Java/HTML interface
  - Native web language and protocols
  - Platform independent delivery
- Secure connection between Java client & server

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ToolBook II Librarian

- Manages student access to courses
- Manages administrator access to student and course records
- Monitors student activity
- Stores student records
- Reports on student and course activity

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ToolBook II Librarian

- Two basic users:
  - Administrators
  - Students
- Student logs in, sees courses assigned
- Bookmarked to last screen
- Administrator logs in, adds, deletes, modifies student and course information

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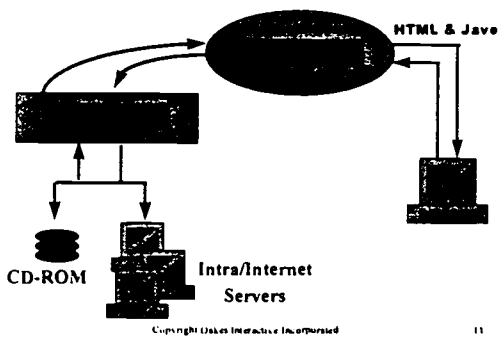
ToolBook II Librarian



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Demo

Live Test Drive

New Features in 6.0

- Organizations
- Roles
- Inheritance
- Conditions
- Lesson Structure
- Properties
- Collaboration
- Content Objects

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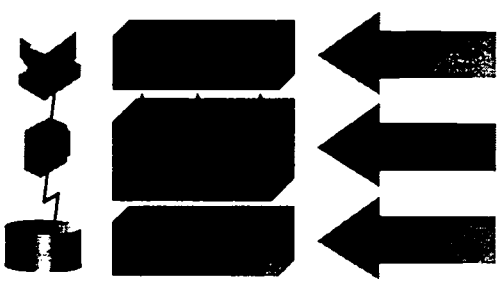
Librarian V6.0 - Components



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Demo

Live Test of Marvin (Beta)

Open Library Exchange (OLX™)

- Open standard that allows any course authored in any tool to be managed by Librarian
  - Solaris or NT
  - Web Server = HTTP 1.x, CGI 1.x
  - ODBC 2.x compliant
  - Navigator 2.x, Internet Explorer 3.x (Java enabled)

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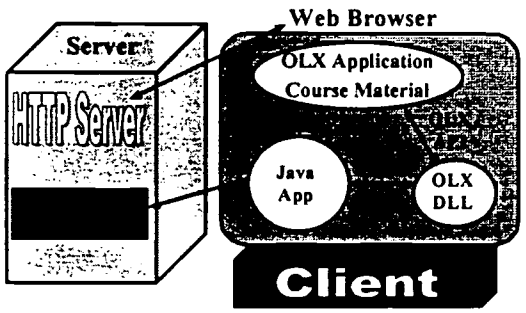
Open Library Exchange (OLX™)



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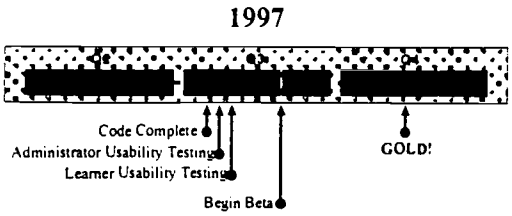
Librarian V6.0 Schedule



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Organizations

- A mechanism to group people
- Can contain other organizations
- May have enrollment conditions
- Can be "Auto Enrollment"
- Can be "Open Enrollment"

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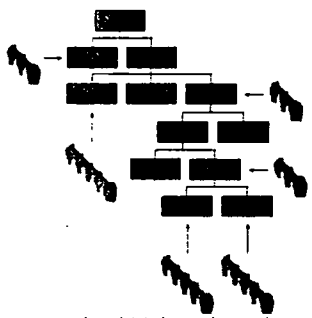
Organizations (Deep)



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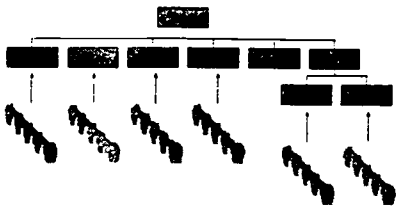
Organizations (Wide)



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Roles

- Can be assigned to a person
- Can be assigned to an organization
- Each may have multiple roles
- Roles have "targets"
- Roles are inherited

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Role Examples

- Learner (can "attempt" Lessons)
- Instructor (can assign Lessons)
- Organizer (can create Organizations)
- Evaluator (can change Scores)
- Administrator (can create/change Roles)
- Designer (can create/change Lessons)
- and on and on and on...

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Conditions

- Time (day of week, time of day, etc.)
- Membership (must belong to organization)
- Property (must have property)
- Lesson completion
  - Must have completed...
  - Must have passed...
- Applicable to Lessons, Orgs., or People

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Collaboration Options

- E-mail support
- Threaded discussion groups
- Chat

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Questions?

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Adaptive Learning Environments

Ninth Annual Instructional Technology Institute
Utah State University
August 27 - 30, 1997

ID2 Research Group
Department of Instructional Technology
Utah State University

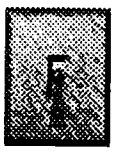
River Park
Instructional Technologies

Overview of presentation
Designing Adaptive Learning Environments

- Knowledge objects and properties
- PEAnets (process, entity, activity relationships)
- Device simulation using a PEAnet
- Instruction using PEAnet
- Learning guide using a PEAnet
- Modeling the student using a PEAnet
- Learning monitor using a PEAnet

Knowledge Objects

- NAME
  - Switch
- DESCRIPTION
  - Turns light on or off
- PORTRAYAL
  - see picture at right



Knowledge Objects are the building blocks for Adaptive Learning Environments.

Properties of Knowledge Objects

- Property name: switch position
- Legal values of property: down, up
- Indicator (portrayal of legal values):

- Current value:

Kinds of Knowledge Objects

- Entity -- an object
  - switch, lamp
- Activity -- an action of the learner
  - flip switch
- Process -- what happens
  - light lamp

Knowledge Object PEAnet

entity: switch

activity: flip switch
triggers
process: toggle switch
changes property switch position to up

indicator up

entity: lamp

triggers
process: light lamp
changes property lamp lighted to on

indicator on

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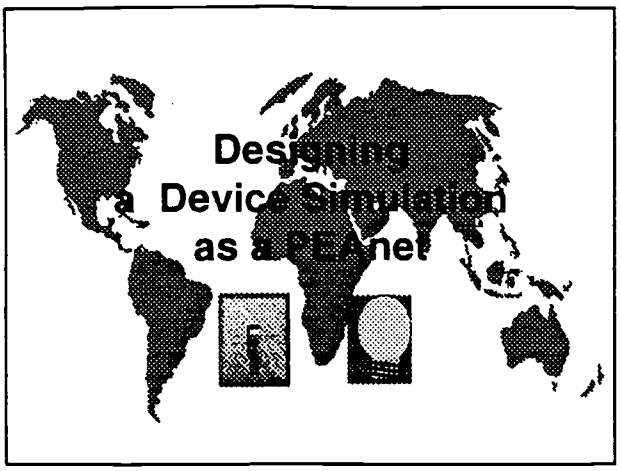


Designing a Device Simulation

- Make entity switch a simulation object.
- Define property switch position.
- Define process toggle switch.
- Define activity flip switch.

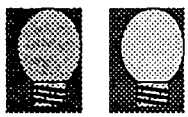
- Make entity lamp a simulation object.
- Define property lamp lighted.
- Define property lamp burned out.
- Define process light lamp.

Entity: Switch

- **Name**: switch
- **Description**: fswitch.rtf
- **Property**: switch position
- **Legal values**: up, down
- **Indicator**: multi graphic
- **Action**: flip switch
- **Process**: toggle switch

Entity: Lamp

- **Name**: lamp
- **Description**: burnout.rtf lightup.rtf flamp.rtf
- **Property**: lamp lighted
- **Legal values**: on, off
- **Indicator**: multi graphic
- **Property**: burned out
- **Legal values**: true, false
- **Process**: light lamp
- **Process**: replace lamp
- **Process**: lamp no good
- **Action**: Break lamp
- **Action**: Fix lamp



Action: Flip switch
triggers
Process: Toggle switch

- **condition** -- switch position = down
- **consequence** -- set switch position to up
- **feedback** -- audio click
- **trigger**: process light lamp

- **condition** -- switch position = up
- **consequence** -- set switch position to down
- **feedback** -- audio click
- **trigger**: process light lamp

Process: Light lamp

- **condition** -- lighted = off
  burned out = false
  switch position = up
- **consequence** -- set lamp lighted to on

- **condition** -- lighted = on
- **consequence** -- set lamp lighted to off

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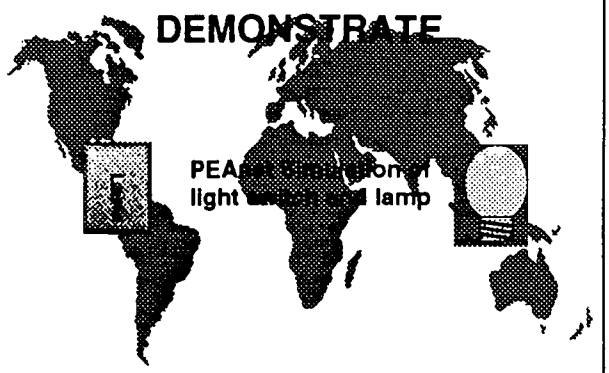
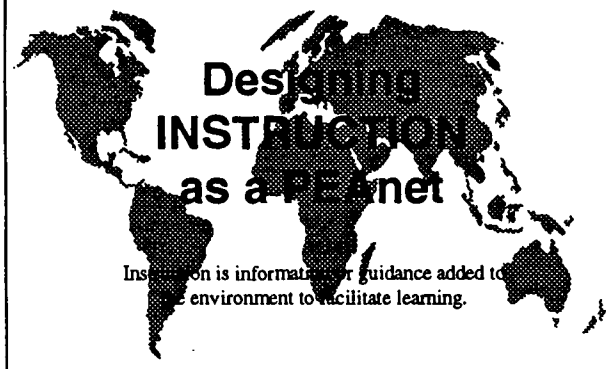
Action: break lamp
triggers
Process: lamp no good

- consequence: set lamp property burned out to true
- trigger: light lamp

Action: fix lamp
triggers
Process: replace lamp

- consequence: set lamp property burned out to false
- trigger: light lamp





Designing instruction as a PEAnet

- Define **process** show function of switch
- Define **process** show function of lamp
- Define **action** "Show me your function" for switch
- Define **action** "Show me your function" for lamp

Add action and process to entity switch

Entity: Switch

- **Name**: light switch
- **Description**: Turns lamp on or off.
- **Property**: switch position
- **Legal values**: up, down
- **Indicator**: multi graphic
- **Action**: flip switch
- **Process**: toggle switch
- **Action**: "Show me your function."
- **Process**: show function

Add action and process to entity lamp

Entity: Lamp

- **Name**: lamp
- **Description**: Lights up the room.
- **Property**: lighted
- **Legal values**: on, off
- **Indicator**: multi graphic
- **Property**: burned out
- **Legal values**: true, false
- **Indicator**: ----------
- **Process**: light lamp
- **Action**: "Show me your function."
- **Process**: show function

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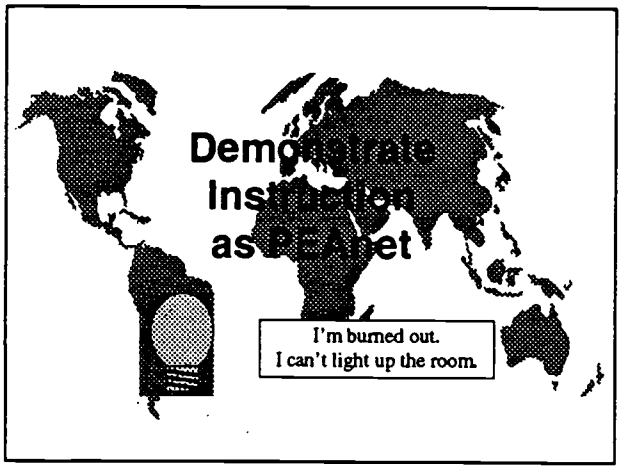
Action: "Show me your function."
triggers
Process: show function of switch

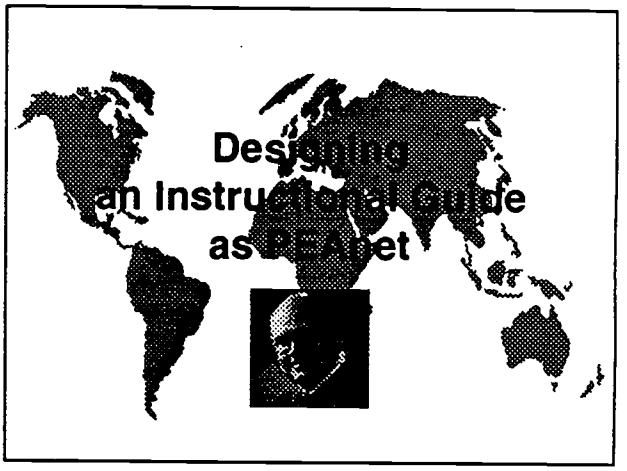
- **condition:** ---------
- **consequence:** ----------
- **feedback:** display text file - fswitch.rtf
- **trigger:** ----------

Action: "Show me your function."
triggers
Process: show function of lamp

- **condition:** burned out = true
- **consequence:** ----------
- **feedback:** display text file - burnout.rtf
- **trigger:** ----------

- **condition:** burned out = false
- **consequence:** ----------
- **feedback:** display text file - lightup.rtf
- **trigger:** ----------





Design Instructional Guide

- Make entity instructional guide a simulation object.
- Define process lecture introduction.
- Define process lecture conclusion.
- Define process function lecture
- Define action Tell me about circuits.

Entity: Instructional Guide

- **name:** M. David Merrill
- **description:** ----------
- **portrayal:** see photo
- **action:** Tell me about circuits.
- **process:** lecture introduction
- **process:** lecture conclusion
- **process:** function lecture

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Action: "Tell me about functions."

triggers

Process: Function Lecture

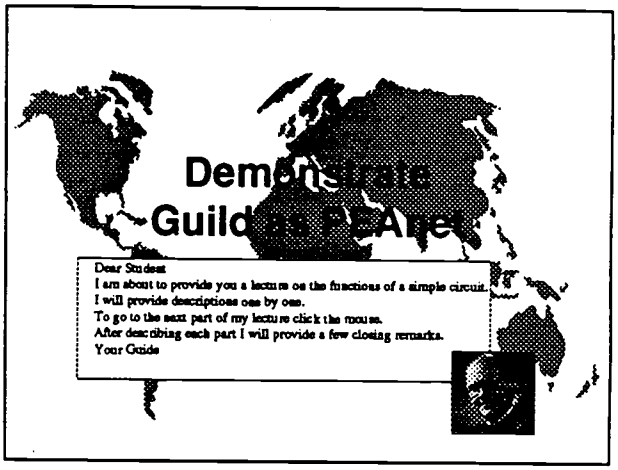
- **condition:** ------
- **consequence:** --------
- **feedback:** ---------
- **trigger:** process lecture introduction
- **trigger:** process show function of switch
- **trigger:** process show function of lamp
- **trigger:** process lecture conclusion

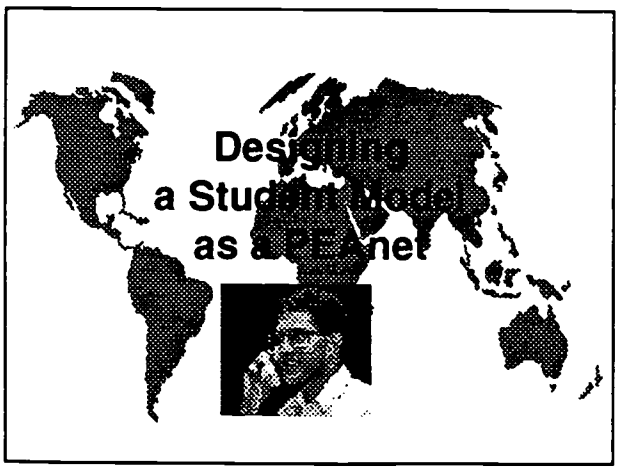
Process: Lecture Introduction

- **condition:** ---------
- **consequence:** ---------
- **feedback:** display text file - lecintro.rtf
- **trigger:** ---------

Process: Lecture conclusion

- **condition:** ---------
- **consequence:** ---------
- **feedback:** display text file - lectend.rtf
- **trigger:** ---------





Designing a Student Model

- Make the entity student a simulation object.
- Define student property learning style.
- Define student process toggle learning style.
- Define student action change learning style.
- Add condition to process show function of switch.
- Add condition to process show function of lamp.
- Add condition to process lecture introduction of guide.
- Add condition to process lecture conclusion of guide.

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Entity: student model

- **name**: John Doe
- **description**: male, college age
- **portrayal**: see photo
- **property**: learning style
- **legal values**: auditory, verbal
- **indicator**: ----------
- **process**: toggle learning style
- **action**: change learning style.

It is not necessary to show portrayal of student.

Action: change learning style
triggers
Process: toggle learning style

- **conditon**: learning style = auditory
- **consequence**: set learning style to verbal

- **condition**: learning style = verbal
- **consequence**: set learning style to auditory

Add conditions to
Process: show function of switch

- **condition**: learning style = verbal
- **feedback**: display text file - fswitch.rtf

- **condition**: learning style = auditory
- **feedback**: display audio file - fswitch.wav

Add conditions to
Process: show function of lamp

- **condition**: burned out = true + learning style = verbal
- **feedback**: display text file - burnout.rtf

- **condition**: burned out = false + learning style = verbal
- **feedback**: display text file - lightup.rtf

- **condition**: burned out = true + learning style = auditory
- **feedback**: display text file - burnout.wav

- **condition**: burned out = false + learning style = auditory
- **feedback**: display text file - lightup.wav

Add conditions to
Process: Lecture Introduction

- **condition**: learning style = verbal
- **feedback**: display text file - lecintro.rtf

- **condition**: learning style = auditory
- **feedback**: display audio file - lecintro.wav

Add conditions to
Process: Lecture conclusion

- **condition**: learning style = verbal
- **feedback**: display text file lectend.rft

- **condition**: learning style = auditory
- **feedback**: display audio file lectend.wav

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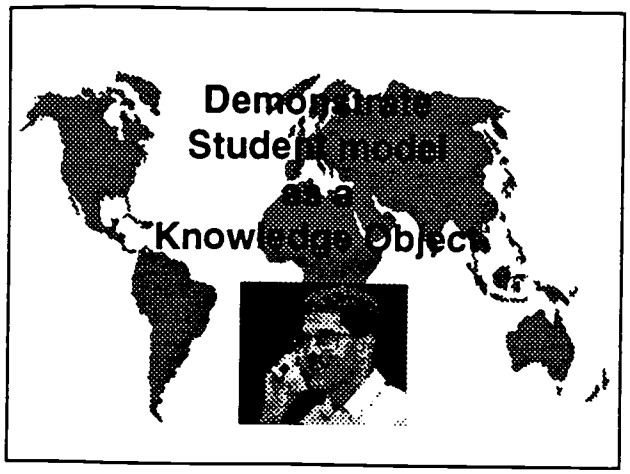

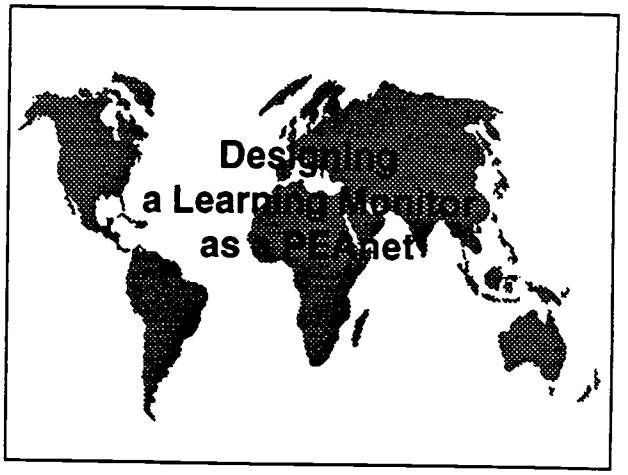

Designing learning monitor

- Make entity learning monitor a simulation object.
- Define student property switch known.
- Define student property lamp known.
- Define student property burned out lamp known.
- Define student property learner motivation.
- Define student process studied switch.
- Define student process studied lamp.
- Devine student process studied burned out lamp.
- Define student process reset learning.
- Define student process toggle motivation.
- Define guide process learner control message.
- Define student action undo learning.
- Define student action change motivation.

Entity: learning monitor

- name: big brother
- description:
- portrayal:
- process: monitor achievement
- action: "I've finished studying this module."

Action: "I've finished studying this module."
triggers
Process: monitor achievement

- condition: learner property switch known = seen
  learner property lamp known = seen
  learner property burned out lamp known = seen
- feedback: play audio file - goodjob.wav

- feedback: play audio file - morestdy.wav
- trigger: guide process function lecture

Add properties, processes, activities to Entity: Student Model

- name: John Doe
- description: male, college age
- portrayal: see photo
- property: learning style, values: auditory, verbal
- property: switch known; values: seen, unseen
- property: lamp known; values: seen, unseen
- property: burned out lamp known; values: seen, unseen
- property: motivation; values: low, high
- process: toggle learning style
- process: studied switch
- process: studied lamp
- process: studied burned out lamp
- process: reset learning
- process: toggle motivation
- action: change learning style.
- action: undo learning
- action: change motivation

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Process: studied switch

- **consequence**: set learner property switch known to seen

Process: studied lamp

- **consequence**: set learner property lamp known to seen

Process: studied burned out lamp

- **consequence**: set burned lamp known to seen

Add trigger to
Process: show function of switch

- **condition**: learning style = verbal
- **feedback**: display text file - fswitch.rtf
- **trigger**: student process studied switch

- **condition**: learning style = auditory
- **feedback**: display audio file - fswitch.wav
- **trigger**: student process studied switch

Add trigger to
Process: show function of lamp

- **condition**: burned out = true + learning style = verbal
- **feedback**: display text file - burnout.rtf
- **trigger**: student process studied lamp

- **condition**: burned out = false + learning style = verbal
- **feedback**: display text file - lightup.rt
- **trigger**: student process studied lamp

- **condition**: burned out = true + learning style = auditory
- **feedback**: display text file - burnout.wav
- **trigger**: student process studied lamp
-
- **condition**: burned out = false + learning style = auditory
- **feedback**: display text file - lightup.wav
- **trigger**: student process studied lamp

Action: show me your function
triggers
Process: show function of switch or show function of lamp and increment motivation

- **consequence**: increment motivation by 1

- **Action**: Break lamp
- triggers: process lamp no good
  increment motivation

Action: undo learning
triggers
Process: reset learning

- consequence:
  set learner property switch known to unseen
  set learner property lamp known to unseen
  set learner property burned out lamp known to unseen
  set learner property motivation to low

Modify learning guide
Process: function lecture

- **condition**: learner property motivation = high
- **feedback**: play audio message - Lcmsg.wav

- **condition**: learner property motivation = low or medium
- **trigger**: process lecture introduction
- **trigger**: process show function of switch
- **trigger**: process show function of lamp
- **trigger**: process lecture conclusion

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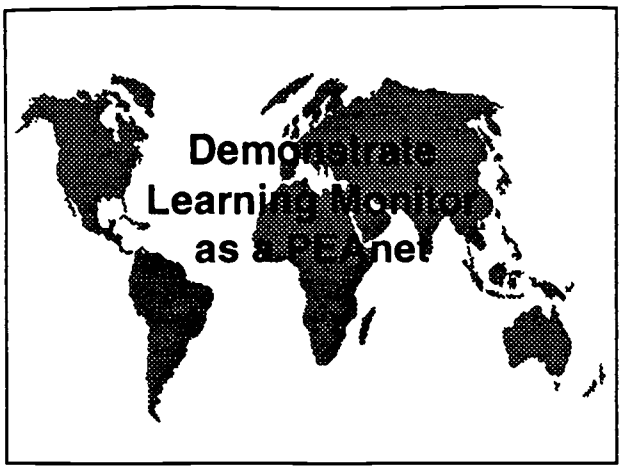

Summary

- Knowledge objects
- PEAnet
- Device simulation using a PEAnet
- Instruction as a PEAnet
- Guide as a PEAnet
- Student as a PEAnet
- Monitor as a PEAnet

PEAnets enable Adaptive Learning Environments

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NEW WORKSHOP AVAILABLE
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"Instructional Design based on Knowledge Objects"

Washington D.C. October 16 - 18, 1997

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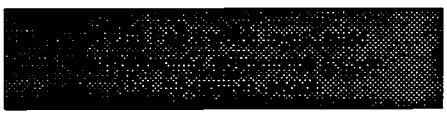
Thank You

M. David Merrill
Utah State University



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